US ROUTE 460 DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SUPPLEMENTAL TRAFFIC AND TRANSPORTATION TECHNICAL REPORT

USACE FEDERAL PROJECT NUMBER: NAO-2008-03470 | FHWA FEDERAL PROJECT NUMBER: STP-000S (276)
STATE PROJECT NUMBER: 0460-969-059, P101, C501; UPC: 100432

JUNE 2016

PREPARED BY:

Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

US Army Corps of Engineers ®

ROUTE 460 LOCATION STUDY:
FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENTAL TRAFFIC AND TRANSPORTATION TECHNICAL REPORT

460

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SOUTHEAST VA

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June 2016

ROUTE 460 LOCATION STUDY
PRINCE GEORGE, SUSSEX, SURRY, SOUTHAMPTON
AND ISLE OF WIGHT COUNTIES AND THE CITY OF SUFFOLK
FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

FHWA Federal Project Number: STP-000S (276)

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Supplemental Traffic and Transportation Technical Report (TaTTR)

PREPARED FOR:

THE VIRGINIA DEPARTMENT OF TRANSPORTATION

June 2016

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1.0 INTRODUCTION

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA) and the United States Army Corps of Engineers (USACE) as joint lead federal agencies, has evaluated options for highway transportation improvements along the existing U.S. Route 460 (Route 460) corridor between Interstate 295 (I-295) in Prince George County and Holland Road (Route 58) in the City of Suffolk, Virginia.

In September 2014, the Draft Supplemental Environmental Impact Statement (SEIS) was issued to analyze five Build Alternatives and a No Build Alternative. Following the publication of the Draft SEIS in September 2014, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts, including potential Council of Environmental Quality (CEQ) referral, and the cost opinions that had been developed. However, in addition to the Draft SEIS supporting the ability to select one of the five alternatives studied or the No Build Alternative, it also supported combining sections of those alternatives, including the No Build Alternative, to form an alternative not individually evaluated as a standalone alternative in the Draft SEIS.

As a result, VDOT carefully reconsidered each of the Draft SEIS alternatives – in whole, in parts, and in hybrid combination with one another – in order to identify a single alternative that would sufficiently address the identified project Purpose and Need, while minimizing environmental impacts and providing a cost effective project. VDOT, in close coordination with FHWA, developed a Preferred Alternative that would consist of a combination of alternatives evaluated in the Draft SEIS, including the No Build Alternative and Build Alternatives 4, 2N, 3, and 1 (from west to east). This FHWA/VDOT Preferred Alternative consists of implementing the No Build Alternative between I-295 and one mile west of Zuni, upgrading the existing Route 460 between one mile west of Zuni and two miles west of Windsor, and constructing a new four-lane divided highway from west of Windsor to a new Route 460/Route 58 interchange in Suffolk.

In February 2015 the Commonwealth Transportation Board (CTB) approved the location for the Route 460 corridor improvements, consistent with the FHWA/VDOT Preferred Alternative. Additionally, the USACE stated in January 2015[1] that it did not find reason to disagree with the assessment that FHWA/VDOT's Preferred Alternative appears to be the Least Environmentally Damaging Practicable Alternative (LEDPA), noting that the USACE comments do not constitute a final LEDPA determination or indication of a permit decision (Note: the Preferred Alternative identified in tables and figures throughout the Final SEIS and Technical Reports refers to the FHWA/VDOT Preferred Alternative).

Prepared in accordance with the implementing regulations of the National Environmental Policy Act (NEPA) at 23 CFR §771.130 and 40 CFR §1502.9(c), the Final SEIS addresses public and agency comments received on the September 2014 Draft SEIS, documents the FHWA and VDOT identified Preferred Alternative and the updated analysis associated with the FHWA/VDOT Preferred Alternative, and documents the action of the CTB.

[1] Olsen, Colonel Paul B. Letter to Aubrey Lane, Jr. 9 Jan. 2015. Norfolk, Virginia.

1.1 TRAFFIC AND TRANSPORTATION

This report addresses the topics of transportation and traffic in the study area. It presents the existing conditions in the study area, including roadway characteristics, traffic volumes, and safety. It highlights information relative to traffic operations for the Preferred Alternative. The report includes traffic forecasting information for both the No Build and Build conditions. It then presents a variety of operational and comparative analyses including: traffic operations, travel time, vehicle miles traveled, safety, hurricane evacuation, and freight mobility.

1.2 BACKGROUND

In May 2005, FHWA published a Draft Environmental Impact Statement (DEIS) for the Route 460 Location Study that evaluated three candidate build alternatives (CBAs) as well as the No Build Alternative and Transportation System Management (TSM) Alternative. Following the publication of the 2005 DEIS, VDOT held two public hearings presenting the technical findings of the draft analysis. In November 2005, the CTB selected the new location alternative south of existing Route 460, with an alignment shift in Isle of Wight County to reduce residential and wetland impacts (referred to as Modified CBA 1), as the preferred alternative. A Final Environmental Impact Statement (FEIS) was prepared that analyzed the environmental consequences of the preferred alternative in greater detail and was approved by FHWA in June 2008. FHWA issued a Record of Decision (ROD) in September 2008 selecting Modified CBA 1 to address the identified Purpose and Need. In November 2012, FHWA completed a NEPA Re-evaluation of the FEIS and in particular, Modified CBA 1, giving consideration to funding the project through the implementation of tolls. In reviewing the information presented in the 2008 FEIS and the 2012 NEPA Re-evaluation, the USACE indicated that the Commonwealth's preferred alternative did not appear to be the LEDPA when compared to improving the existing road. Further development of additional information and analyses of the Commonwealth's preferred alternative resulted in an increase in the acreage of wetlands identified in the Modified CBA 1 corridor compared to the acreage of wetlands presented in the 2008 FEIS. In 2013, FHWA and USACE determined that the preparation of an SEIS would be necessary in order to analyze new information with a bearing on the environmental impacts, particularly aquatic resource impacts. The SEIS also was determined to be necessary in order for the USACE to fulfill its statutory obligations under NEPA and as part of its decision making process to issue or deny authorization for impacts associated with the Route 460 corridor improvements.

The Draft SEIS was published in September 2014 and presented at three Location Public Hearings that took place in October 2014.

The Draft SEIS provided detailed analysis of five Build Alternatives (Alternatives 1-5) that met the Purpose and Need, including two alternatives on a new alignment (Alternatives 1 and 3), one alternative with improvements to the existing Route 460 (Alternative 4), alternatives that included a combination of new location alignment (with bypasses of the towns) with varying improvements to existing Route 460 between the towns (Alternatives 2N/S and 5N/S), and the No Build Alternative. The No Build Alternative included all planned and programmed transportation improvements in the study area that had been approved and adopted for implementation by 2040.

Following the publication of the Draft SEIS, VDOT determined that none of the five Build Alternatives evaluated over the extent of the study corridor would be viable options based on public comments that were received, input from the resource and regulatory agencies regarding the estimated environmental impacts including potential CEQ referral, and the cost opinions that had been developed. In order to identify a single alternative that was less impactful, as well as less costly, while sufficiently addressing the Purpose and Need, VDOT explored a combination of segments from the Draft SEIS alternatives in various configurations to develop hybrid alternatives. The goal of the hybrid development was to arrive at a recommendation for a preferred alternative that could be considered the LEDPA while sufficiently addressing the project's Purpose and Need and providing a cost effective solution. Refer to the ***Supplemental Alternatives Technical Report*** (VDOT, 2016e) for additional information regarding the hybrid development and refinement process.

In January 2015 VDOT, in close coordination with FHWA reconsidered the alternatives studied in the Draft SEIS and developed a 52-mile FHWA/VDOT Preferred Alternative, which included the No Build Alternative over most of its length (36 miles), with portions of four alternatives from the Draft SEIS (4, 2N, 3, and 1) for 16 miles. Since the identification and approval of the location of the FHWA/VDOT Preferred Alternative, further refinements were applied in order to avoid and minimize impacts to the greatest extent practicable. The FHWA/VDOT Preferred Alternative, including these further refinements, has been carried forward for detailed evaluation in the Final SEIS.

1.3 PURPOSE AND NEED

The purpose of the improvements to the Route 460 corridor is to construct a facility that is consistent with the functional classification of the corridor, sufficiently addresses safety, mobility and evacuation needs, and sufficiently accommodates freight traffic along the Route 460 corridor between Petersburg and Suffolk, Virginia.

The following needs have been identified for the project:

- Address roadway deficiencies: Route 460 is based on outdated geometric standards.
- Improve safety: Fatality rates for Route 460 are higher than other comparable rural roadways in Virginia.
- Accommodate increasing freight shipments: Truck percentages for Route 460 are higher than national averages for rural roads with a similar functional classification. Truck volumes are also forecast to grow due to expansions at the Port of Virginia.
- Reduce Travel Delay: Future traffic volumes will result in increased travel delays on Route 460 due to capacity limitations at traffic signals and due to the current design deficiencies.
- Provide adequate emergency evacuation capability: Route 460 is a designated hurricane evacuation route for Southside Hampton Roads communities, yet during recent events, the road was closed due to effects caused by these storms.
- Improve strategic military connectivity: Route 460 is a designated part of the Strategic Highway Network (STRAHNET) by the Department of Defense (DOD) and FHWA.
- Support local economic development plans: In addition to statewide and regional economic development needs, jurisdictions along the Route 460 study area have identified economic development priorities related to transportation improvements.

Through the evaluation of hybrid alternatives, which is detailed in the ***Supplemental Alternatives Technical Report*** (VDOT, 2016e), the following were identified as key improvements necessary for addressing the Purpose and Need, even if these improvements involved a hybrid alternative less than the full length of the Route 460 corridor.

- Improvements are needed along Route 460 at the Blackwater River to address longstanding flooding issues associated with safety and evacuation concerns and roadway deficiency.
- Improvements are needed at Route 58/Route 460 to provide efficient traffic movements to decrease travel time, facilitate increased freight mobility, and better accommodate emergency evacuation.
- Improvements to the eastern portion of the corridor to improve safety, as this area has the largest number of conflict points compared to the rest of the corridor; enhancements to travel time, freight mobility, and evacuation from the coastal areas would be better realized with improvements to the eastern portion of the corridor.

Based on the identification of these key components necessary for addressing the Purpose and Need, geographic limits for the hybrid alternative were refined within the eastern portion of the study corridor, where these key project components were focused and the elements of need had been demonstrated in the Draft SEIS as more pronounced. In developing hybrids, it also was important to consider opportunities to minimize environmental impacts, such as displacements and aquatic resources, and costs. Following a detailed evaluation of hybrid alternatives that focused on the eastern portion of the study corridor, FHWA/VDOT Preferred Alternative was ultimately identified as the most effective improvement option for the 16 miles for which the improvements were considered; it best addresses the project's Purpose and Need, while balancing cost, displacements, and wetlands.

1.4 FINAL SEIS ALTERNATIVES

Two alternatives are included in the Final SEIS – the FHWA/VDOT Preferred Alternative and the No Build Alternative. Following is a description of each alternative.

1.4.1 No Build Alternative

The No Build Alternative has been included to serve as a baseline for comparison of future conditions and impacts. The No Build Alternative includes all planned and programmed transportation improvements within the study area that have been approved and adopted for implementation by 2040, as identified in the VDOT Six Year Improvement Program (SYIP). These planned and programmed improvements would be developed and implemented independent of the implementation of the FHWA/VDOT Preferred Alternative. The No Build projects within the study area and projects that have the potential to affect capacity within the study area are listed in **Table 1-1**.

Table 1-1: No Build Projects within the Route 460 Study Area Jurisdictions

Locality	VDOT UPC / MPO ID	Description
Prince George	100499	Construction of added left turn lane on westbound Route 460 at Enterprise Drive (Route 657).
	82849	Construction of added left turn lanes on northbound Bull Hill Road (Route 630) onto Route 460 in Prince George County.
	105110	Construction of right turn lanes on Courthouse Road (Route 106) at its intersection with Prince George Drive (Route 616).
	104847	Construction of added left turn lane on Route 156.
Surry	107529	Improvements to Route 627 by widening, improving the drainage on, and straightening the roadway.
Sussex	N/A	No projects listed.
Southampton	N/A	No projects listed.
Isle of Wight	58297	Construction of added left and right turn lanes on Courthouse Highway (Route 258) at its intersection with Scotts Factory Road (Route 620).
	103021	Construction of a right turn lane on Turner Drive (Route 644) at the intersection with Benns Church Boulevard (Route 10/32).
Suffolk	104333	Improvements to drainage and stormwater management facilities along Pruden Boulevard (Route 460).
	102994	Intelligent transportation system (ITS) improvements to 11.6 miles of the Suffolk Bypass (Route 58) from the City of Chesapeake to Holland Road.
	100937	Reconstruction with added capacity on Route 58/Holland Road between the Route 58/13/32 bypass to just west of Manning Bridge Road.
	102998	Intersection improvements to Suffolk Bypass Off-Ramp at Godwin Boulevard. Construction of second exclusive right turn lane and traffic signal improvements.
	104332	Improvements to the intersection of Godwin Boulevard (Route 10) and Kings Highway (Route 125).

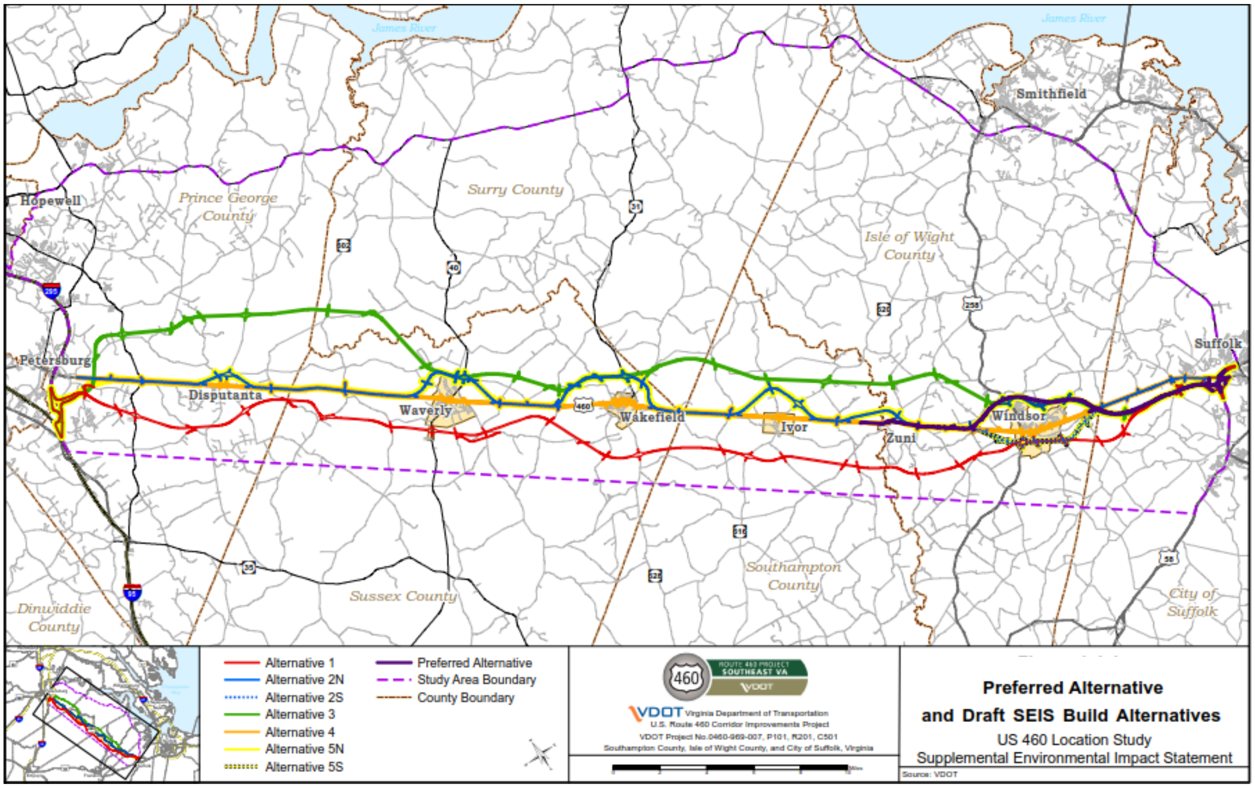
Source: Virginia Department of Transportation FY 2016 Final SYIP; Hampton Roads 2040 Long Range Transportation Plan: Committed and Candidate Transportation Projects, September 2014.

1.4.2 FHWA/VDOT Preferred Alternative

The FHWA/VDOT Preferred Alternative is a 52-mile corridor between I-295 in Prince George County and Route 58 in Suffolk. **Figure 1-1** illustrates the FHWA/VDOT Preferred Alternative compared to the Build Alternatives from the Draft SEIS. Following is a description of the FHWA/VDOT Preferred Alternative, from west to east:

- from I-295 to approximately one mile west of Zuni the No Build Alternative would be implemented (approximately 36 miles);
- from approximately one mile west of Zuni to two miles west of Windsor the existing US 460 would be upgraded to a four-lane divided highway and include a new bridge across the Blackwater River to eliminate long standing flooding problems (approximately 4 miles);
- from approximately two miles west of Windsor to the US 460/58 interchange in Suffolk, a new four-lane divided highway would be constructed, running north around Windsor, then east of Windsor running south of the existing US 460 (approximately 12 miles).

Figure 1-1: FHWA/VDOT Preferred Alternative and the Draft SEIS Build Alternatives



1.4.3 Inventory Corridor and Design Corridor

In order to identify resources along the Build Alternatives analyzed in the Draft SEIS, a 500-foot wide Inventory Corridor was developed to identify resources within a reasonable proximity of each alignment. None of the alternatives were anticipated to impact all of the resources identified within their respective Inventory Corridors as these corridors did not reflect the actual impacts of each of the alternatives in comparison to one another. Instead the Inventory Corridors were developed for the purposes of providing greater flexibility to further avoid and minimize impacts as design advanced.

In order to estimate impacts and compare alternatives, the conceptual designs and typical sections were applied to each Build Alternative in the Draft SEIS to develop a Design Corridor to represent the likely "footprint" for each alternative. The reported impacts in the Draft SEIS were based upon the Design Corridor, which included roadway width, proposed right-of-way, and construction limits. The Design Corridor for each alternative was able to be shifted within the Inventory Corridor to avoid or minimize impacts to resources with knowledge of the consequences of those shifts. In addition, both the SEIS Inventory and Design Corridors were adjusted as necessary to account for design elements associated with each Alternative, including interchanges, at-grade intersections, side road overpasses, interface geometry with bypasses, etc. Details regarding the design elements that were factored into the development of each alternative and the typical sections developed for them are included within the appendices of the ***Alternatives Technical Report*** (VDOT, 2014e).

Design and engineering were advanced in order to develop the permit application for the FHWA/VDOT Preferred Alternative, which requires that the Design Corridor, a planning level design, be refined to understand the specific area to be impacted by the project, known as the Limits of Disturbance (LOD). As described in the sections that follow, the typical sections were refined to more accurately reflect the anticipated LOD, which includes both temporary and permanent impacts, including stormwater management facilities and construction access. To the extent practicable, the LOD was developed to avoid and minimize impacts to resources, including wetlands and streams. This LOD has been used to calculate predicted impacts of the FHWA/VDOT Preferred Alternative.

2.0 EXISTING ROADWAY CONDTIONS

2.1 STUDY AREA

The study area for evaluating traffic and transportation for the FHWA/VDOT Preferred Alternative extends from Main Street in Ivor (Southampton County) to Godwin Boulevard in Suffolk as shown in **Figure 2-1**. These limits were selected because they represent the next major intersections on existing Route 460 beyond the extent of improvements associated with the FHWA/VDOT Preferred Alternative. It includes Route 460 and key side-street intersections through the communities of Ivor (Southampton County), Zuni and Windsor (Isle of Wight County), and part of the City of Suffolk. The study area also covers portions of Route 58 and Godwin Boulevard to account for the interaction between Route 460 and these major roadways.

2.2 EXISTING STUDY AREA ROADWAYS

Route 460 from Ivor to Suffolk is the focus of this study. However, there are several other significant state and local highways in the study area that are important to understanding the study area transportation system, as described below.

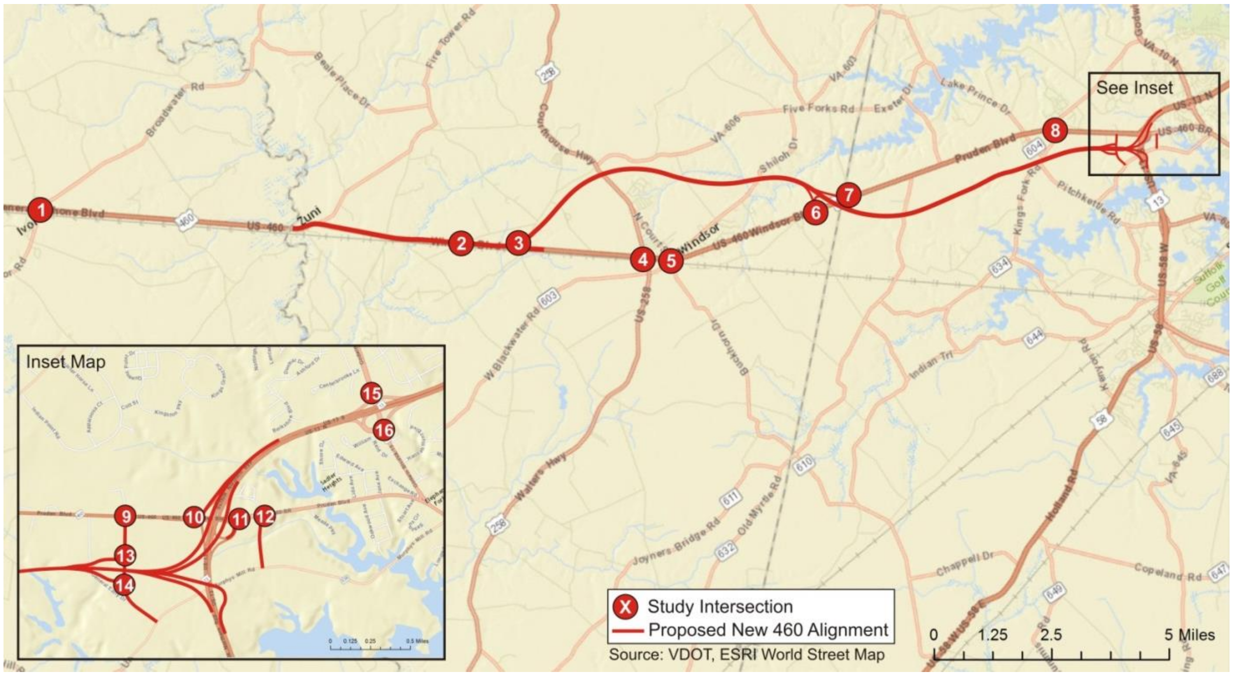
2.2.1 US Route 460

Route 460 is a major transportation corridor connecting the Hampton Roads and the Richmond regions. It provides an alternative to the often congested I-64 corridor, especially for access to the southern portion of the Hampton Roads region. Because of the connections it offers, it is used as a trucking corridor, with direct access to Petersburg, and points beyond via I-95, I-85 and I-64. It is also used by recreational travelers.

Route 460 is functionally classified as a rural principal arterial from Zuni to the Isle of Wight/ Suffolk Corporate Limit. From the county line to the Route 58 interchange, Route 460 is an urban principal arterial. At the Route 58 interchange, Route 460 heads north on the Route 58 freeway alignment. Business Route 460 continues east to Godwin Road as an urban principal arterial. Route 460 has various names through the study area including General Mahone Boulevard (Ivor to Zuni), Windsor Boulevard (Zuni to Windsor), and Pruden Boulevard (Windsor to Route 58).

The existing typical section along the Route 460 corridor generally consists of a four-lane, undivided roadway with two eastbound and two westbound lanes, no access control, limited shoulder widths, and roadside ditches or guardrail. This typical section varies in the towns and at the eastern end of the corridor with some locations having a combination of curbs and sidewalks, as well as turn lanes. The typical lane width in the corridor is 11 feet and there are limited clear zones in some locations. There are numerous public and private access points throughout the corridor ranging from major cross-streets to single family homes. Following is a description of Route 460 as it travels between Ivor and Suffolk.

Figure 2-1: Study Area



Ivor to Windsor

In Ivor Route 460 has a five lane cross-section with a center two-way left turn lane (TWLTL) and a posted speed of 45 mph. Between Ivor and Zuni, the cross-section shifts to four lanes undivided with a 55 mph speed limit. Upon entering Zuni the speed limit drops to 45 mph (just east of the bridge over the Blackwater River). In Zuni there are several intersections and driveways, but there are no turn lanes and the shoulders are limited. Between Zuni and Windsor the speed limit increases to 55 mph, retaining the same four-lane undivided cross-section. **Figure 2-2** shows a photo of Route 460 between Zuni and Windsor.

Figure 2-2: Route 460 Between Zuni and Windsor

Windsor

As Route 460 approaches Windsor, the posted speed decreases to 45 mph and then drops to 35 mph just prior to and through the town. In Windsor there are left turn turns lanes at Route 258 and at the Food Lion grocery store; however, the remainder of the corridor is four-lane undivided without left turn lanes. There are curbs and sidewalks in the center of town. **Figure 2-3** shows Route 460 on the east side of Windsor in the 35 mph zone. As shown, there are power line poles and other objects a short distance from the travel way.

Figure 2-3: Route 460 on the East side of Windsor

Windsor to Lake Prince Drive

East of Windsor the posted speed increases to 45 mph and then increases back to 55 mph. It remains 55 mph until Lake Prince Drive where it drops to 45 mph. In this segment, there are left and right turn lanes at the two industrial development intersections and Old Mill Road. There are also turn lanes at Lake Prince Road and a right turn lane at the Pruden Center for Industry and Technology. The rest of the segment is four-lane undivided without left turn lanes. In this section there is a 45 mph school speed zone for the Pruden Center for Industry and Technology, located 0.6 miles west of Lake Prince Drive.

Lake Prince Drive to Sadler Pond Drive

The posted speed limit remains 45 mph from Lake Prince Drive through the Route 58 interchange to the east. At Kings Fork Road the cross section transitions to five-lanes to accommodate a TWLTL with dedicated left turn lanes at major intersections. This five-lane section stops east of Nansemond Suffolk Academy. At that point there are dedicated turn lanes at Northfield Drive, the western truck stop driveway, the Route 58 southbound ramp intersection, and Sadler Pond Drive. There is a 35 mph school speed zone east of Kings Fork Road for Nansemond Suffolk Academy.

2.2.2 Main Street/State Route 616 (Southampton County)

Main Street in Ivor (Route 616) is a two-lane rural major collector. It intersects Route 460 from the south at a signalized three-leg intersection. Route 616 continues north of Ivor as Proctors Bridge Road.

2.2.3 Fire Tower Road/State Route 644 (Isle of Wight County)

Fire Tower Road in Zuni (State Route 644) is a two-lane rural minor collector to the north of Route 460. It intersects Route 460 at an unsignalized skew intersection. South and west of Route 460, the roadway continues as a local roadway, Zuni Circle, for approximately 0.5 miles and connects back to Route 460. South of Zuni Circle is an access road that passes under the Norfolk Southern Railroad then connects to State Route 614.

2.2.4 US Route 258/Prince Boulevard (Isle of Wight County)

Route 258 is a two-lane rural minor arterial in the study area. It intersects Route 460 at a signalized four-leg intersection. From a larger perspective, Route 258 is a 220-mile long north-south highway connecting Route 460 in Windsor to Hampton Roads to the north and various destinations in Virginia and North Carolina to the south. Destinations to the north of Route 460 include the Cities of Smithfield, Newport News, and Hampton, the latter two via the James River Bridge, the westernmost fixed crossing of the James River in the Hampton Roads region. To the south, major destinations along Route 258 include the City of Franklin in Virginia and the Cities of Murfreesboro, Greenville, Kinston, and Jacksonville in North Carolina. Route 258 is designated as Prince Boulevard in Windsor, Courthouse Highway north of the town, and Walters Highway to the south.

2.2.5 Court Street/State Route 610 (Isle of Wight County)

Court Street (Route 610) is a north-south two-lane rural minor collector that intersects Route 460 at the six-leg intersection in the center of Windsor. Through trucks are prohibited from using Court Street.

2.2.6 Church Street/Bank Street/State Route 603 (Isle of Wight County)

Church Street/Bank Street (Route 603) is an east-west two-lane rural major collector that intersects Route 460 at the six-leg intersection in the center of Windsor. It is designated as Bank Street southwest of Route 460 and Church Street northeast of Route 460. Through trucks are prohibited from using Bank Street.

2.2.7 King’s Fork Road (City of Suffolk)

King’s Fork Road is a two-lane urban minor arterial that provides access to the developing area north of Route 460 at the eastern end of the corridor. It connects to Godwin Boulevard (Route 32) in the east.

2.2.8 Godwin Boulevard/State Route 32/10 (City of Suffolk)

Godwin Boulevard (Route 32/10) is a four-lane urban principal arterial at the eastern end of the study area. From the Godwin Boulevard/Route 58 interchange it connects south to downtown Suffolk and north to developing areas north of Route 58. It continues north toward Smithfield and the James River Bridge.

2.2.9 Route 58 (City of Suffolk)

Route 58 in the study area is a four-lane freeway that bypasses north of Suffolk. Route 460 connects to Route 58 at a service interchange at the east end of the corridor.

2.3 EXISTING TRAFFIC VOLUMES

2.3.1 Analysis Locations

The following study area intersections, roadway segments, and interchange configurations were selected for analysis.

2.3.1.1 Intersections

The following intersections were determined to be important to current or future traffic operations in the corridor (No Build and/or Build). They include the intersections studied previously as well as three additional intersections. Future intersections are in italics.

1. Route 460 at Route 616/Main Street in Ivor (existing, signalized)
2. Route 460 at Winston Dr/Route 639 (existing, unsignalized)
3. *Existing Route 460 at New Route 460 (future, Green-T)*
4. Existing Route 460 at Route 258/Prince Blvd (existing, signalized)
5. Existing Route 460 at Routes 610/603/1810 (existing, signalized)
6. *Existing Route 460 at East Bound (EB) New Route 460 ramps (future, signalized)*
7. *Existing Route 460 at West Bound (WB) New Route 460 ramps (future, signalized)*
8. Route 460 at Route 634/Kings Fork Rd (existing, signalized)
9. Existing Route 460 at Relocated General Early Dr/Northfield Dr (existing, signalized)
10. Existing Route 460 at WB Route 58 Ramps (existing, signalized)
11. Existing Route 460 at EB Route 58 Ramps (existing, signalized)
12. Existing Route 460 at Sadler Pond Dr/Murphy's Mill Connector (existing, signalized)
13. General Early Dr at WB New Route 460 *(future, signalized)*
14. General Early Dr at EB New Route 460 *(future, signalized)*
15. WB Route 58 ramps at Godwin Blvd (existing, signalized)
16. EB Route 58 ramps at Godwin Blvd (existing, signalized)

2.3.1.2 Freeway Segments

All current and future freeway segments in the study area were included in the analysis.

1. *EB New Route 460 between Green-T intersection and Route 460 interchange (future)*
2. *WB New Route 460 between Green-T intersection and Route 460 interchange (future)*
3. *EB New Route 460 west of General Early Dr (future)*
4. *WB New Route 460 west of General Early Dr (future)*
5. *EB New Route 460 west of General Early Dr (future)*
6. *WB New Route 460 west of General Early Dr (future)*
7. *EB New Route 460 between General Early Dr ramps and Route 58 ramps (future)*
8. *WB New Route 460 between General Early Dr ramps and Route 58 ramps (future)*
9. EB Route 58 west of New Route 460
10. WB Route 58 west of New Route 460
11. EB Route 58 between Route 460 and Godwin Blvd
12. WB Route 58 between Route 460 and Godwin Blvd
13. EB Route 58 east of Godwin Blvd
14. WB Route 58 east of Godwin Blvd

2.3.1.3 Ramps and Ramp Junctions

All current and future freeway ramp connections in the study area were included in the analysis.

1. *EB New Route 460 off-ramp to Existing Route 460 (future)*
2. *Existing Route 460 on-ramp to EB New Route 460 (future)*
3. *WB New Route 460 off-ramp to Existing Route 460 (future)*
4. *Existing Route 460 on-ramp to WB New Route 460 (future)*
5. *EB New Route 460 Off-Ramp to General Early Dr (future)*
6. *EB New Route 460 On-Ramp to EB Route 58 (future)*
7. *EB New Route 460 Diverge to EB and WB Route 58 (future)*
8. *EB New Route 460 On-Ramp to WB Route 58 (future)*
9. *EB Route 58 Off-Ramp to WB New Route 460 (future)*
10. *EB and WB Route 58 Ramps to WB New Route 460 Merge (future)*
11. WB Route 58 Off-Ramp to New and/or Existing Route 460
12. *General Early Dr On-Ramp to WB New Route 460 (future)*
13. Existing EB Route 460 On-Ramp to EB Route 58
14. Existing Route 460 On-Ramp to WB Route 58
15. EB Route 58 Off-Ramp to Existing Route 460
16. Existing WB Route 460 On-Ramp to EB Route 58
17. WB Route 58 Off-Ramp to Godwin Blvd
18. Godwin Blvd On-Ramp to WB Route 58
19. EB Route 58 Off-Ramp to Godwin Blvd
20. SB Godwin Blvd On-Ramp to EB Route 58
21. NB Godwin Blvd On-Ramp to EB Route 58
22. *EB New Route 460 On-Ramp to EB Route 58 (future)*
23. *EB New Route 460 On-Ramp to WB Route 58 (future)*
24. *EB Route 58 Off-Ramp to WB New Route 460 (future)*
25. *WB Route 58 Off-Ramp to WB New Route 460 (future)*

2.3.1.4 Multilane Arterial Segments

In addition to the above locations 14 multilane arterial segments were also studied. These locations are listed in the level of service analysis.

2.3.2 Existing Traffic Data

Data were compiled from various sources to develop the existing traffic volumes and operational analysis. Sources include:

- VDOT traffic counts including recent and historical hourly traffic counts for locations on Route 460 and many side streets throughout the area. Some counts were classification counts and two counts were continuous count stations.
- Daily traffic volume estimates (VDOT Traffic Count publications) for Southampton and Isle of Wight Counties and the City of Suffolk. The data include two-way link volumes as part of VDOT's count program for roadways classified as collectors and above.
- Turning movement data including turning movement data from the prior study and new weekday peak hour counts for the new study intersections.
- Segment traffic counts including new directional 24-hour vehicle classification counts at several locations on Route 460 and a count on Route 258.

- Traffic signal timing and phasing data provided by VDOT.
- Geometric data based on the prior study, field observations, and aerial/field photography.

2.3.3 Existing Traffic Volumes

Based on the available data sources, balanced 2013 traffic flows were developed including average weekday traffic (AWDT) volumes, AM peak hour volumes, and PM peak hour volumes. The balanced flows also include truck volumes for the same three time periods. **Figures 2-6 and 2-7** illustrate the balanced existing (2013) volumes for the study area.

West of Zuni the weekday traffic volume is 9,400 vehicles per day with 23% truck traffic (both single-unit and tractor trailers). This is one of the highest truck percentages in the Hampton Roads region for a Rural Principal Arterial with this volume of traffic. To the east, the total traffic volumes increase and the truck percentages decrease due to more residential and suburban development. East of Windsor there are 15,600 daily vehicles with 16% trucks. Near the Route 58/Route 460 interchange the daily volume is 21,700 with 12% trucks. It is important to note that based on the Route 460 count data, the AWDT volumes were determined to be a reasonable estimate of average daily traffic (ADT) volumes in the corridor as well.

The AM peak hour volumes demonstrate an eastbound (inbound) peak in the morning and the volume increases from 300 eastbound vehicles near Ivor to over 1,000 approaching the Route 58/Route 460 interchange. The PM peak hour demonstrates a reverse trend with over 1,000 westbound vehicles near the interchange decreasing to 450 westbound vehicles approaching Ivor.

Figure 2-4 shows the hourly traffic volume distributions for two example count locations, one west of Windsor and one near the Route 58 interchange. As shown the count west of Windsor exhibits somewhat more rural characteristics with a relatively modest AM peak hour and a flat percent of the daily traffic occurring through the middle of the day. The eastern count location has a more typical urban/suburban form, with more distinct AM and PM peaks and lower midday traffic percentages. Neither of the counts exceeds 9 percent of daily traffic during the peak hours. This was a general trend across much of the study area with many count peaks falling in the 7.7 percent to 8.7 percent range.

Figure 2-4: Hourly Distribution of Total Traffic

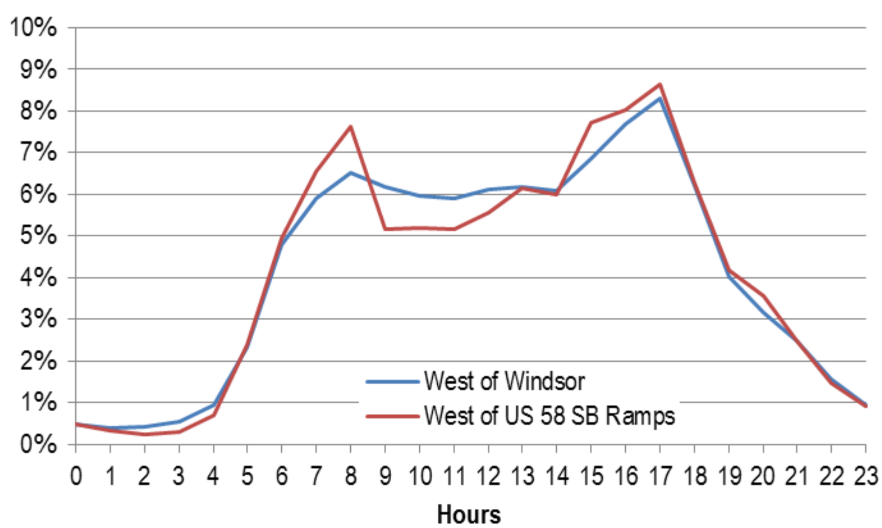


Figure 2-5 shows a truck count location just east of Windsor. Comparing this figure with **Figure 2-4** illustrates the significant difference between the distribution of truck traffic and auto traffic over the course of a typical weekday. The truck traffic increases rapidly in the morning, remains high through the middle of the day, and begins decreasing before the PM peak hour.

Figure 2-5: Hourly Distribution of Truck Traffic

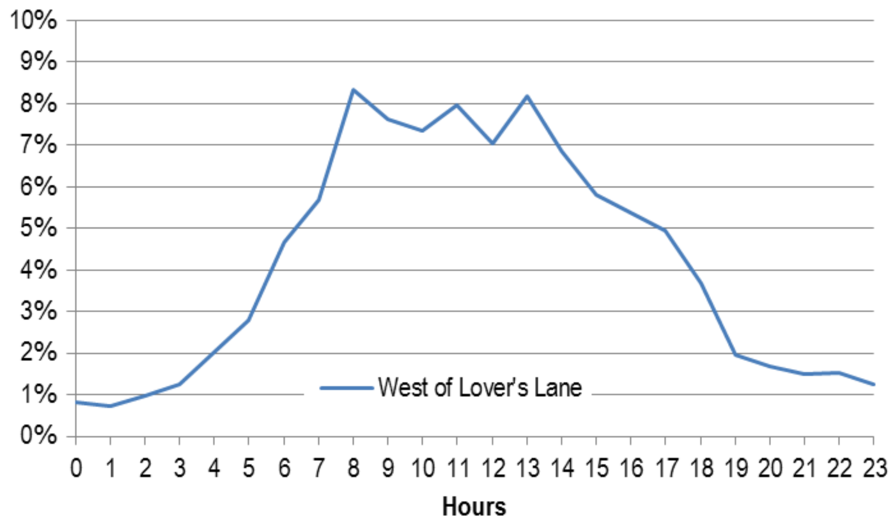
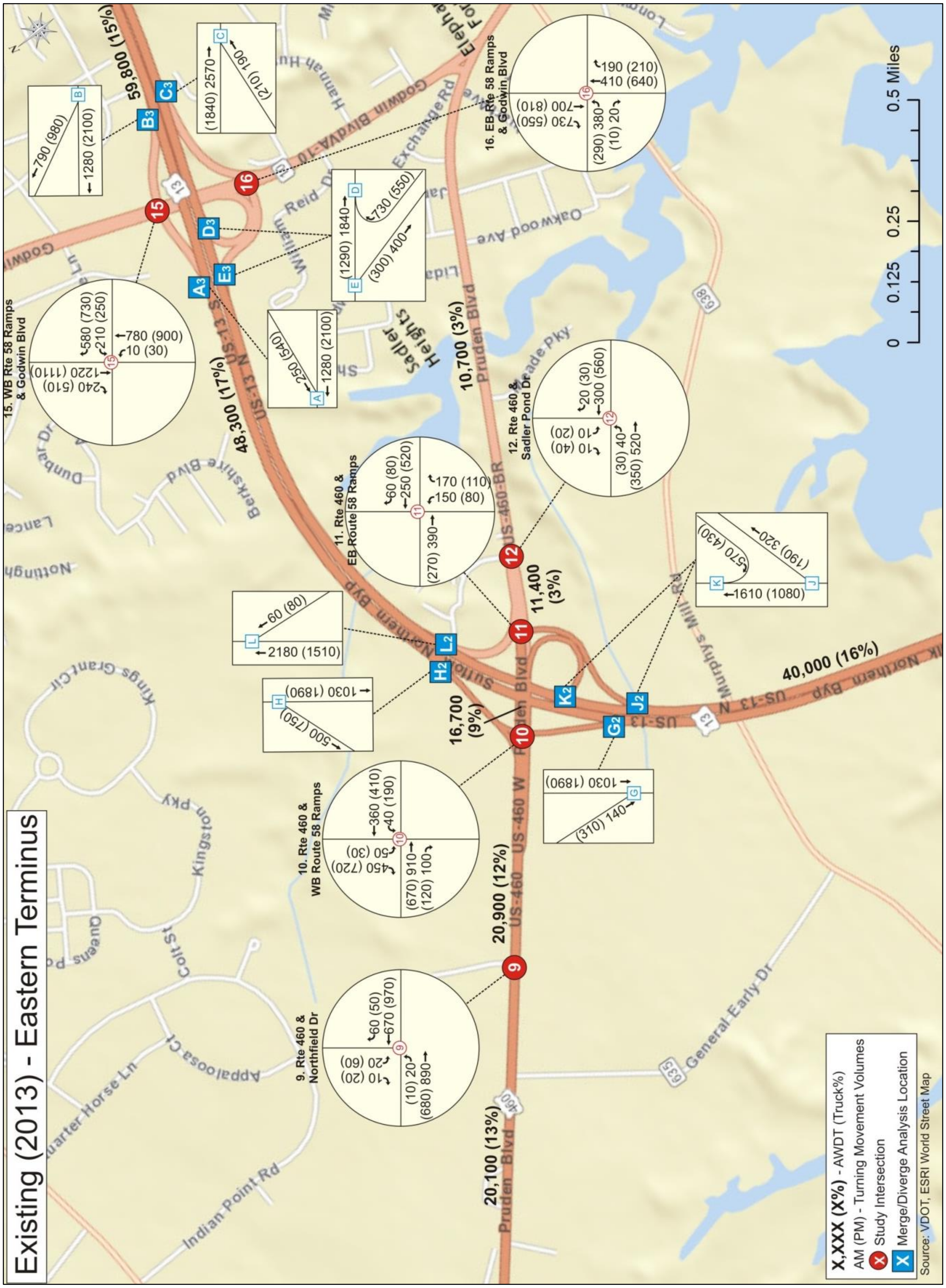


Figure 2-6: Existing (2013) Volumes

Figure 2-7: Existing (2013) Volumes – Eastern Terminus



2.4 SAFETY ANALYSIS

A safety analysis was conducted to examine the crash rates and patterns in the study area, to compare the crash rates to statewide averages, and to consider how the current design affects roadway safety. From January 2010 through December 2012 there were 172 crashes in the study area between the Western Project Limit and the Route 460/Route 58 interchange in Suffolk. This included three fatal crashes (three fatalities), 71 injury crashes (117 injuries), and 98 property damage only crashes. **Figure 2-8** shows the locations of the crashes with highlighting where there are dense clusters of crashes. This figure shows that the majority of crashes were located in Windsor and in the more developed eastern portion of the study area.

Figure 2-8: Study Area Crash Map

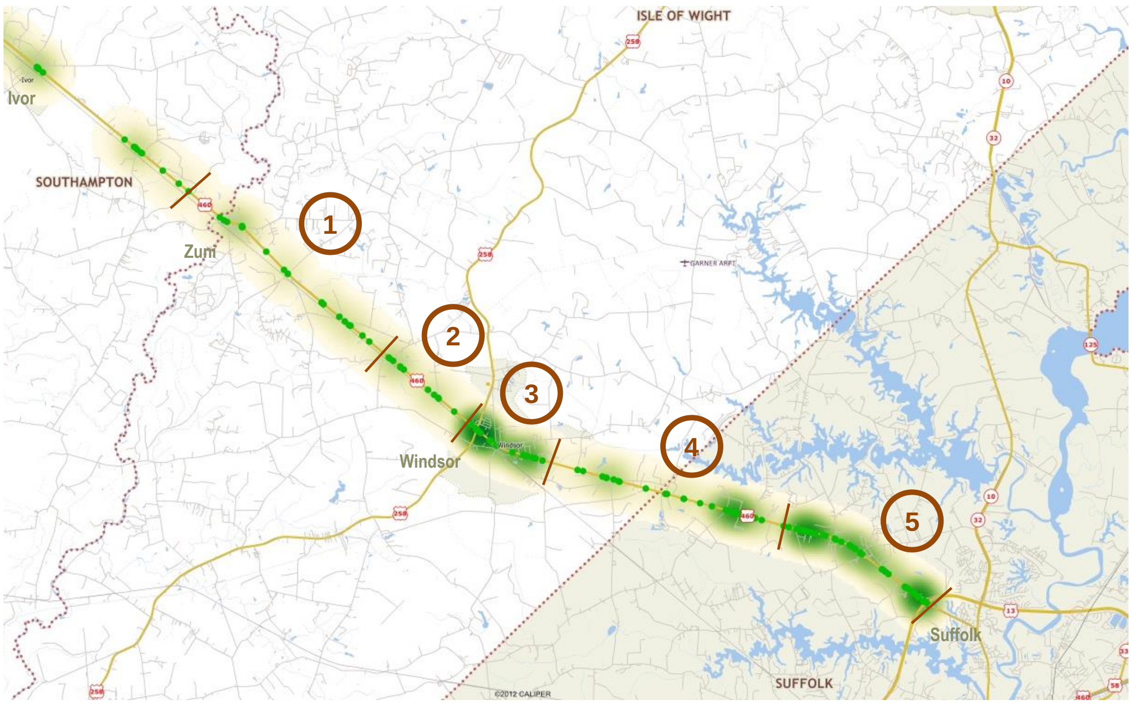


Table 2-1 presents fatal, injury, and total crash rates for the six analysis segments shown on **Figure 2-8**. The rates are per 100 million vehicle miles traveled (MVMT). It also presents the overall crash rate for the study area. Segments 3 and 5 have the highest total crash rates and segments 3 through 5 have the highest injury rates.

Table 2-1: Existing Route 460 Crash Rates (per 100MVMT)

Segment	1	2	3	4	5	All
Crash Rates by Segment	Western Project Limit to West of Antioch	West of Antioch to West of Route 258	West of Route 258 to .3 miles west of Lover's Lane	West of Lover's Lane to West of Lake Prince Dr.	West of Lake Prince Dr to Route 58 Overpass	Entire Corridor
Length (miles)	5.1	2.1	1.8	5.1	2.1	16.1
Total Crashes	23	14	39	54	42	172
Fatal Rate[1]	0.0	4.2	3.5	0.0	2.4	1.3
Injury Rate[1]	35.6	25.5	66.6	56.8	59.3	50.4
Total Crash Rate	43.1	59.5	136.8	63.9	99.6	74.1

Table 2-2 presents Virginia statewide average crash rates for several roadway types, including Rural Other Principal Arterials and four types of four-lane highways (which include both urban and rural highways across multiple functional classifications). It also presents the crash rate for the section of Route 460 from the Western Project Limit to Route 58. Comparing this rate to the statewide averages shows that it is very similar to the Rural Principal Arterial rate (fatal and injury rates are high and total rate is lower). This is consistent with the rural nature of the current highway.

Comparing the Route 460 rate (Western Project Limit to Route 58) to the four-lane highway rates shows that the fatal rate on Route 460 is higher than all of the other statewide rates, but the injury and total rates on Route 460 are lower than all but the divided with full access control statewide rates. Again, this is partially due to the primarily rural nature of the current roadway compared to the combined urban and rural nature of the four-lane rates. It is also due to the limited number of high volume side streets and signalized intersections in the corridor. As the area continues to develop and urbanize, it is expected that the crash rates could begin to reflect urban/suburban trends instead of rural trends.

Table 2-2: Crash Rate Comparisons – Study Area to Other Facility Types (per MVMT)

Crash Rates by Facility Type	Virginia Averages 2012					Route 460 Western Project Limit to Route 58
	Rural Other Principal Arterial	4-Lane Undivided Two-Way	4-Lane Divided No Access Control	4-Lane Divided Partial Access Control	4-Lane Divided Full Access Control	
Fatal Rate[1]	1.2	1.0	1.0	0.7	0.3	1.3
Injury Rate[1]	42.6	156.0	91.7	73.6	31.0	50.4
Total Crash Rate	78.2	252.5	154.8	127.5	61.4	74.1

[1] These rates are based on the total number of fatalities or injuries, not the number of crashes.

Source: VDOT crash data.

To further examine the crash characteristics of the corridor, crash histograms are presented in **Figures 2-9 and 2-10**. The histograms show crashes by type by location (by milepost in half-mile increments) for the study area. Mileposts 364.8 through 365.8 (Route 258 to Roberts Road in downtown Windsor) and mileposts 369.8 to 373.8 (from near Old Myrtle Road to the US 58 interchange) are the areas with the highest number of crashes. Additional crash data are provided in Appendix A.

Using the milepost information, “rolling” crash rates were calculated for the entire corridor. The method used calculates the crash rate for three-tenths of a mile segments throughout the corridor. This method clearly shows where the crash rates peak along the corridor. The upper graph in **Figure 2-11** shows total crashes and the lower graph shows injury and fatal crashes. Several of the four-lane highway statewide crash rates are shown for reference. This comparison shows that much of the corridor is below the statewide crash rates for four-lane undivided highways. However, it also shows that many locations are above the rates for four-lane divided highways. Thus improvements could be made that would reduce the number of crashes from their current level.

Figure 2-9: Segment 1 Route 460 Crash Data Histogram by Crash Type

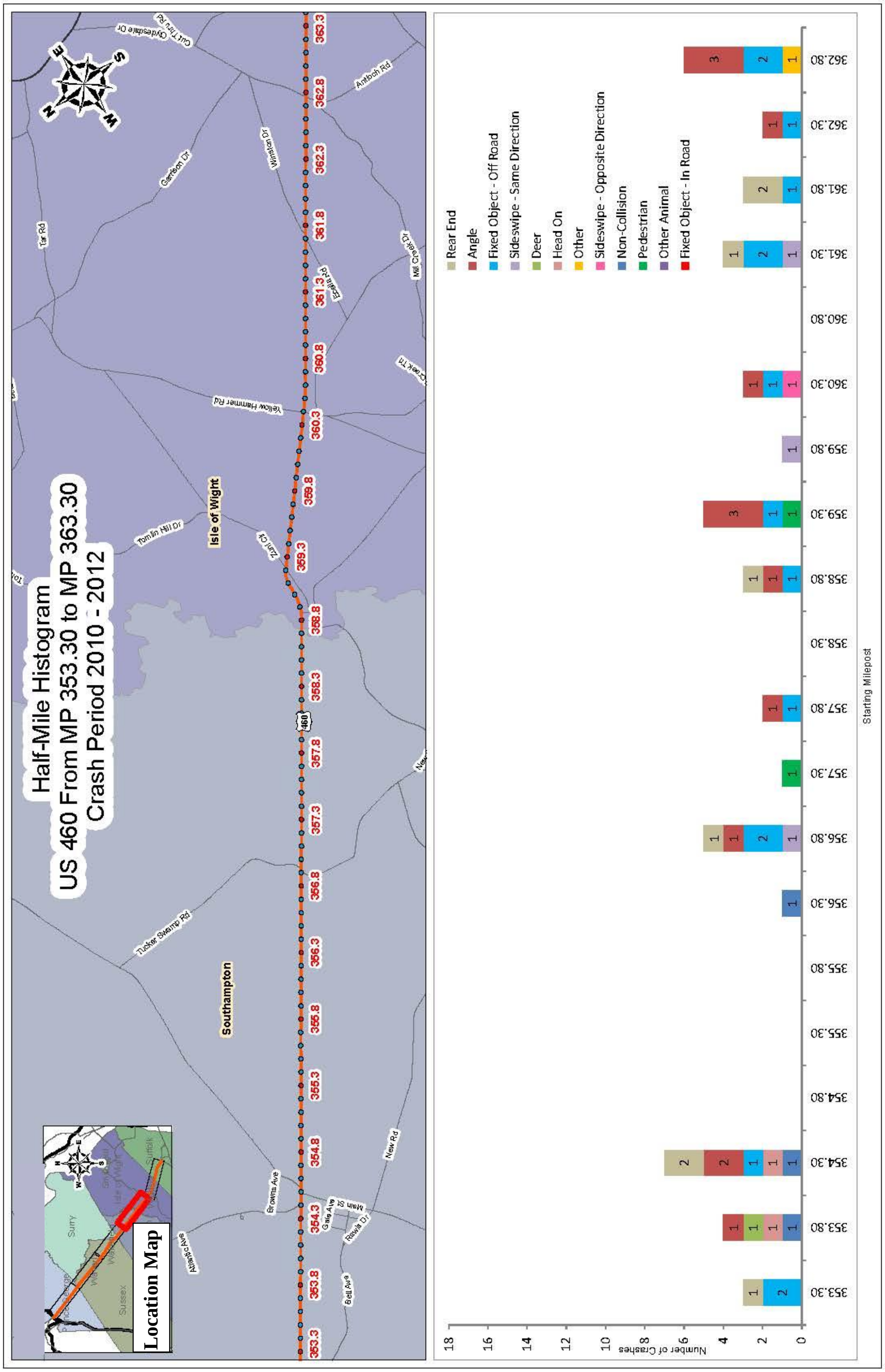


Figure 2-10: Segment 5 Route 460 Crash Data Histogram by Crash Type

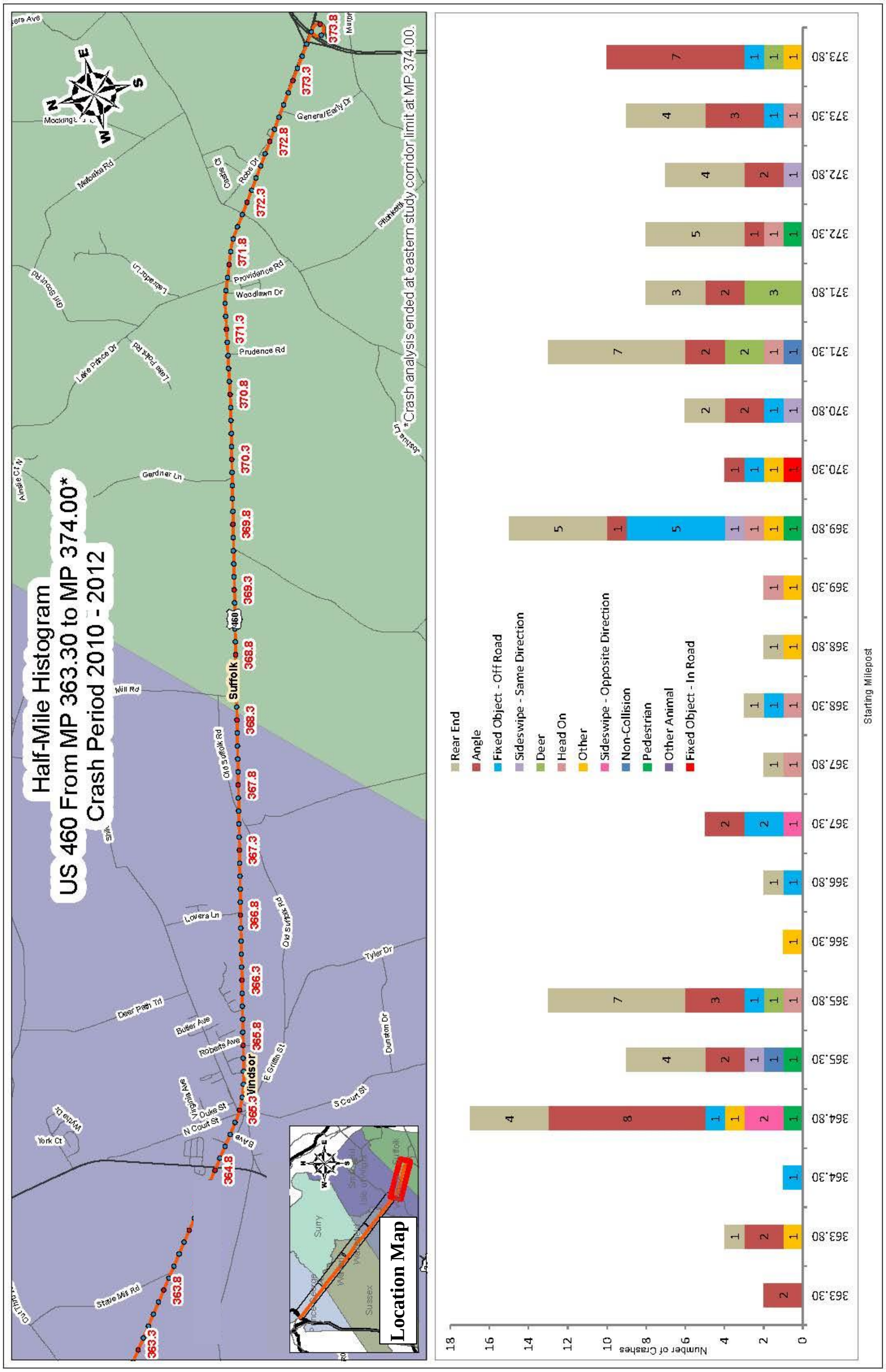
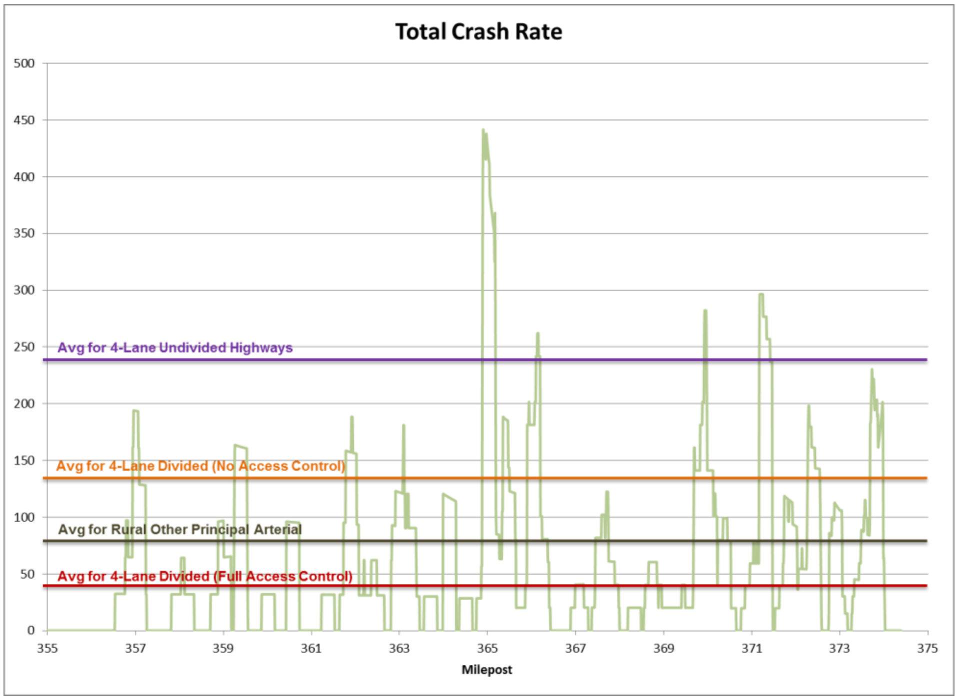
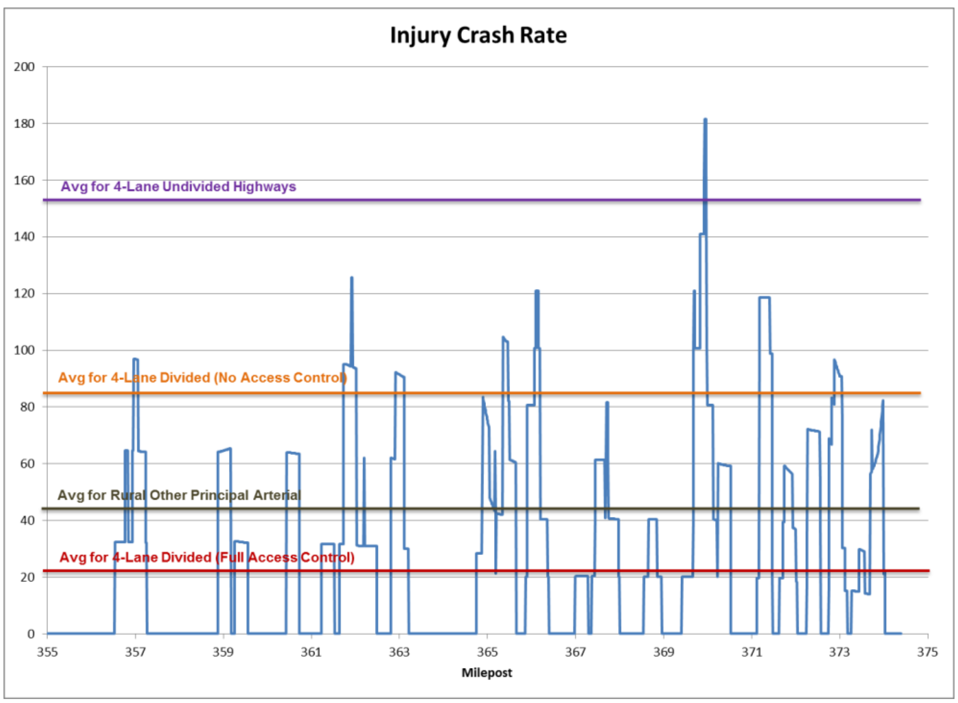


Figure 2-11: Study Area Crash Map





As **Table 2-3** depicts, the predominant crash types within the study area are rear-end crashes at 31 percent, followed by angle collisions at 29 percent, and fixed object off-the-road crashes at 15 percent. These three crash types comprised 76 percent of the total crashes within the study area from 2010 to 2012. Head-on collisions, which tend to have high severities made up 5 percent of the total (six of the eight were fatal or injury crashes).

Table 2-3: Crash by Type within the Route 460 Corridor Study Area (2010 - 2012)

Collision Type	Total	Percentage
Rear-end	54	31.4%
Angle	50	29.1%
Fixed object, off the road	26	15.1%
Miscellaneous	14	8.1%
Head-on	8	4.7%
Deer	7	4.1%
Sideswipe - same direction	6	3.5%
Jackknifes, overturned vehicles, and ran off the road	2	1.2%
Sideswipe - opposite direction	4	2.3%
Fixed-object, in road	1	0.6%
Total	**172**	**100%**

Source: VDOT crash data 2010-2012.

Most of the rear-end and angle crashes occur in downtown Windsor and at the eastern end of the study area where there are increased intersection densities, signalized intersections, higher turning movement volumes, and speed limit transitions. The fixed object crashes are more evenly distributed throughout the corridor under study, from Ivor to Suffolk. The head-on collisions are spread fairly evenly from Windsor to the east. Of the 172 crashes within the study area from 2010 to 2012, 17 crashes (10 percent) involved trucks. One of the fatal crashes and three of the injury crashes also involved a truck.

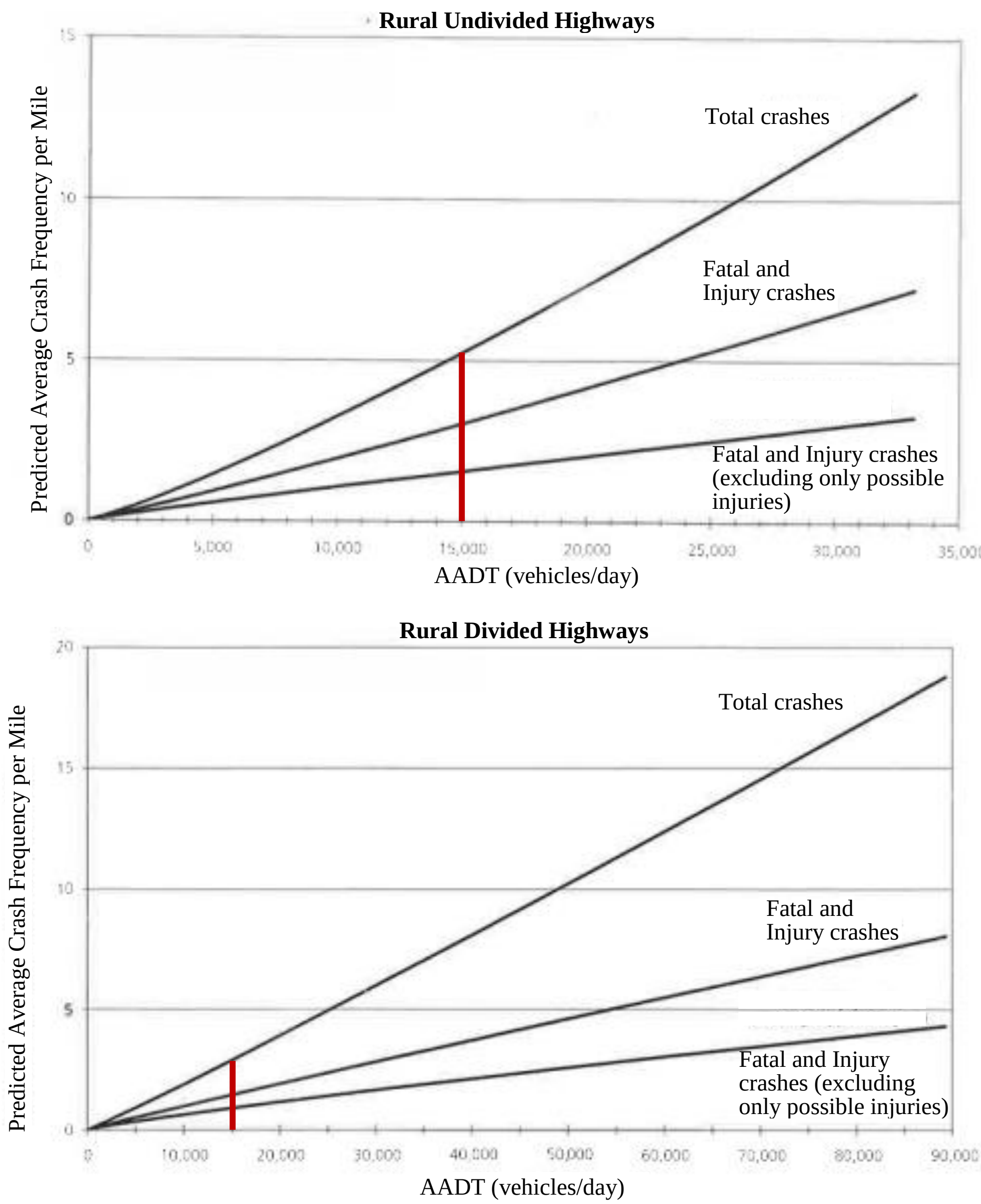
Crash patterns on Route 460 within the study area over the three-year period serve to illustrate the design deficiencies present under existing conditions.

- Rear end and angle crashes, concentrated in Windsor and the eastern portion of the corridor, reflect the problems that typically arise with a transition from higher posted speeds to lower posted speeds and increased intersection densities;
- Crashes with fixed objects off the road reflect the limited shoulder widths and lack of recovery space, which would typically help to reduce this kind of crash.

The three major crash types on Route 460 within the study area are typically addressed through modifications in highway design, including travel lanes separated by a median and access control. In addition, head-on collisions are greatly reduced with divided facilities. These four crash types account for 80 percent of the collisions on Route 460 between 2010 and 2012.

As described previously, Route 460 in the study area is an undivided four-lane principal arterial with no median control, few turn lanes, and many access points. These types of roadways typically have higher average crash rates than other types of four-lane roadways due to the lack of median control and no separation between the two directions of travel. **Figure 2-12** shows the generalized safety performance function (SPF) for rural undivided and divided highways. Using 15,000 vehicles per day as an example volume, the predicted segment crash frequency for undivided highways is over five crashes per mile, while the predicted crash frequency for divided highways is approximately three per mile. The difference between the two values also increases as volumes increase. A review of the expected crash frequencies for urban/suburban roadways also shows a higher number of expected crashes on undivided highways compared to divided highways. The differences are even larger if undivided arterials are compared to freeways. Over time as the corridor develops and traffic increases, especially side street traffic, the crash rates on Route 460 could increase as well.

Figure 2-12: Safety Performance Function



Source: Highway Safety Manual (AASHTO, 2010).

3.0 GEOMETRIC DATA FOR THE ALTERNATIVES

3.1 NO BUILD

In the No Build scenario there are no changes planned for the existing geometric conditions in the study area with the exception of off-ramp intersection improvements at the Route 58/Godwin Boulevard interchange (turn lanes and signal upgrades).

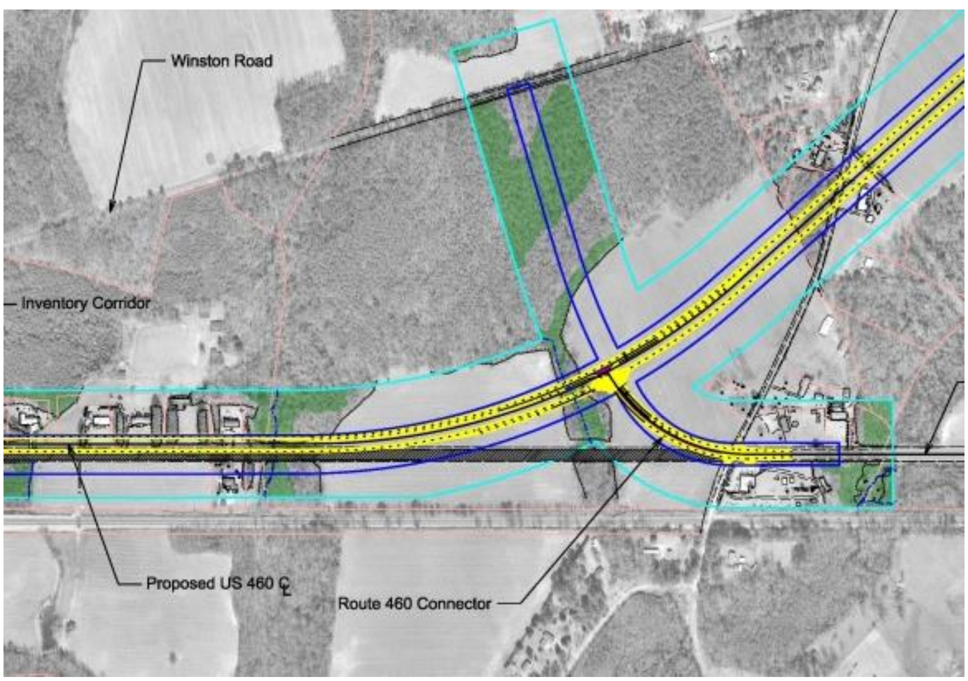
3.2 FHWA/VDOT PREFERRED ALTERNATIVE

The FHWA/VDOT Preferred Alternative was described in **Section 2.0**, with a high level overview of the project. Following is a description of several key details related to intersections and other analysis locations.

Western Bypass Intersection – New Route 460/Existing Route 460 Intersection

This intersection will be designed as a Continuous T intersection with westbound through traffic flowing freely. Eastbound through traffic, westbound left traffic, and northbound traffic will be signal controlled. **Figure 3-1** shows the proposed design of the intersection. It includes two through lanes in each direction, a westbound left turn lane, an eastbound right turn lane, and a two-lane northbound approach (one left turn lane and one right turn lane). The northbound left turn has a median acceleration lane along westbound Route 460.

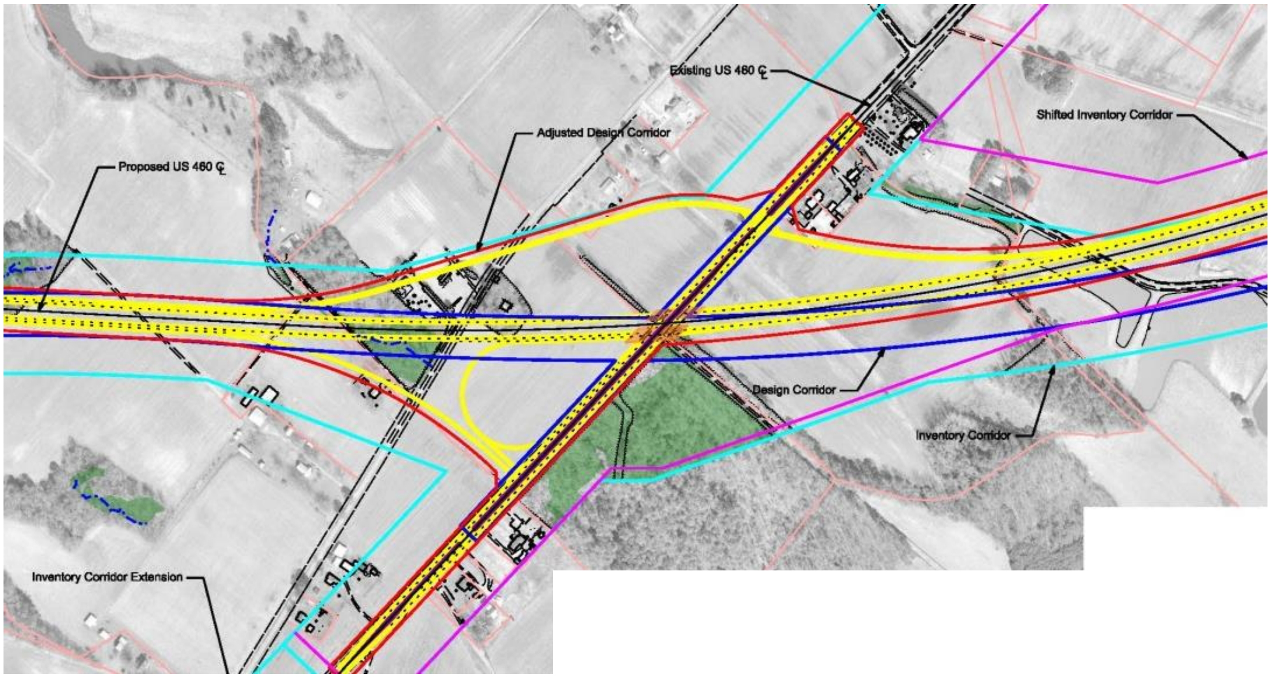
Figure 3-1: Western Bypass Intersection



Eastern Bypass Interchange – New Route 460/Old Route 460 Interchange

The interchange east of Windsor will have three diamond ramps and one loop ramp as shown in **Figure 3-2**. All ramps will be single lane ramps connecting to the freeway. Both ramp terminal intersections will be signalized with turn lanes as shown.

Figure 3-2: Eastern Bypass Interchange



General Early Drive Interchange and Relocated General Early Drive

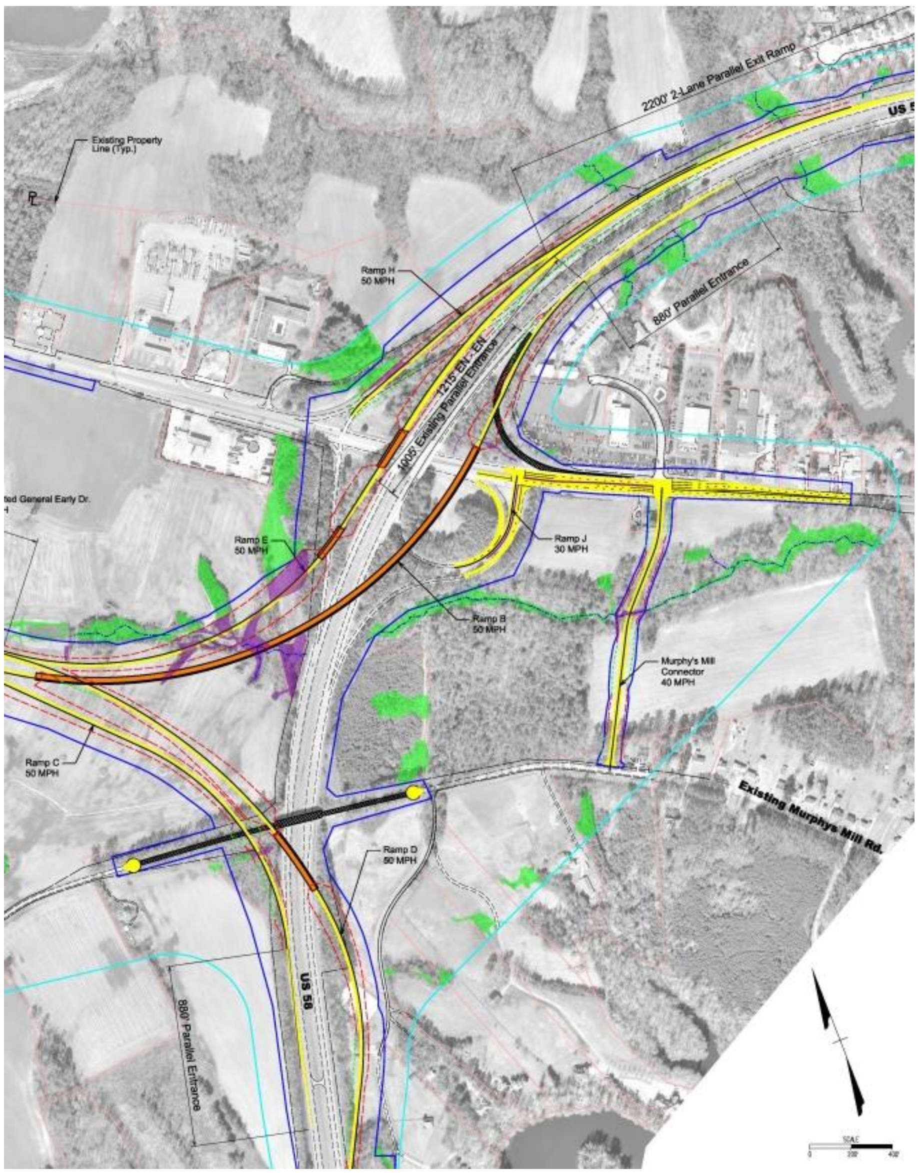
General Early Drive would be relocated to align with Northfield Drive on Existing Route 460. A half diamond interchange would be constructed to connect to the New Route 460. The ramp terminals would be stop controlled and would have turn lanes as shown.

Figure 3-3: General Early Interchange

Eastern Terminus – Route 58 Interchanges and Murphy's Mill Connector

There are significant changes being proposed as part of the FHWA/VDOT Preferred Alternative in the Eastern Terminus area at Route 58. The most significant element of the project in this area is the provision of single-lane free-flow directional ramps connecting Route 460 and Route 58 as shown in **Figure 3-4**. To accommodate these ramps, the existing Route 460 interchange has been modified to eliminate the westbound to northbound ramp and replace it with a westbound left turn connection to the loop ramp. The southbound exit ramp to existing Route 460 was also modified to diverge from Route 58 at the same location as the new southbound ramp to Route 460. The final change shown on this figure is the new Murphy's Mill Connector, which is needed because the Murphy's Mill Route 58 overpass would be eliminated.

Figure 3-4: Eastern Terminus



4.0 TRAFFIC FORECASTING PROCESS

4.1 MODELING BACKGROUND

Route 460 plays a critical role in linking the urbanized areas of Richmond and Hampton Roads. The study corridor also includes portions of two regions defined by VDOT for traffic projections and modeling analyses – the Hampton Roads network and the inter-MPO area network, which includes the Counties of Dinwiddie, Greensville, Prince George, Sussex, Surry, and Southampton. VDOT developed the Tidewater Superregional Model, hereafter referred to as "the model," which allows for the comprehensive modeling and testing of regional alternatives across the entire study area. The model encapsulates the Richmond/Tri-Cities network, Hampton Roads network, and the inter-MPO area network (See **Figure 4-1**).

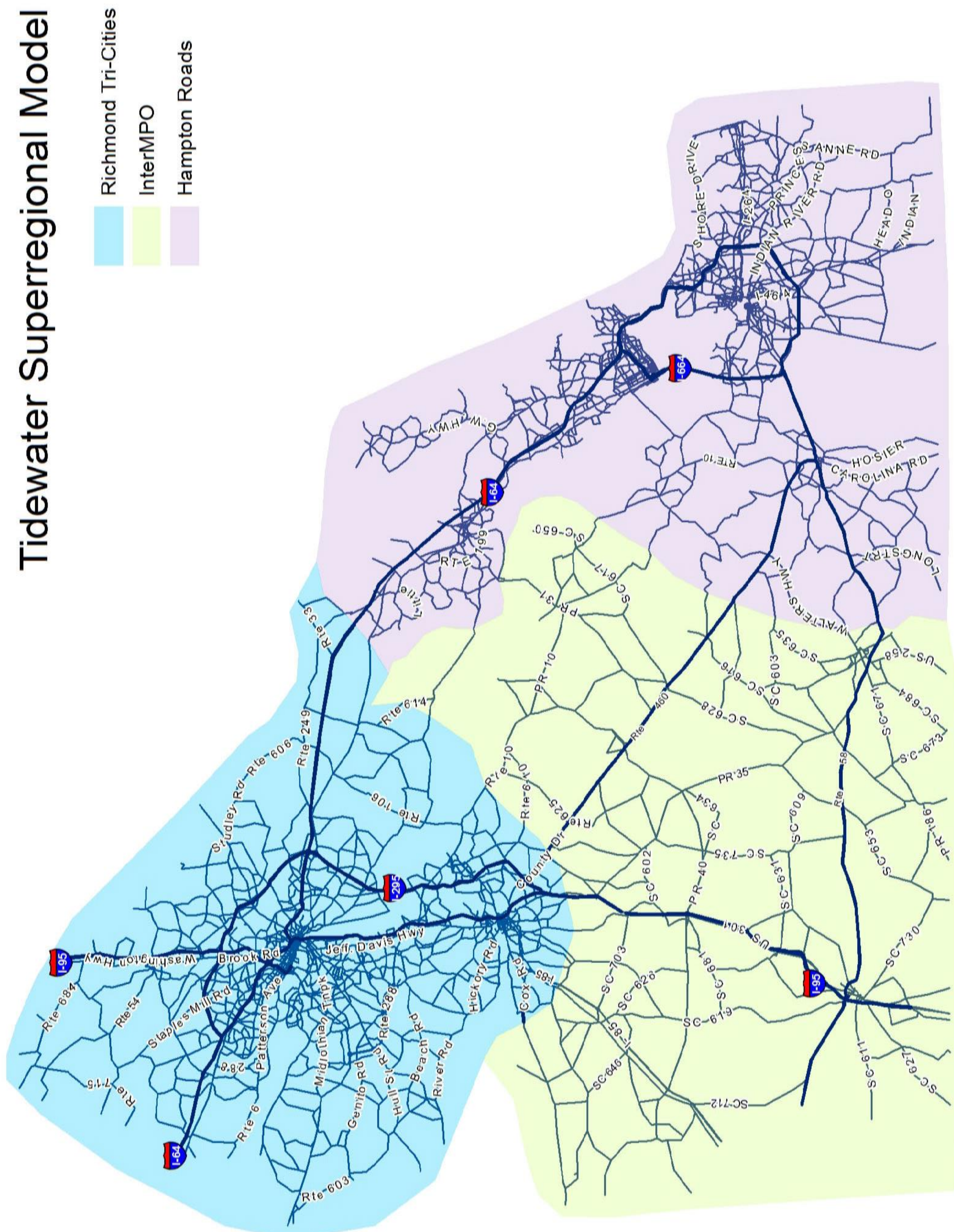
The model is based on a model merging application, which is run within the Cube Voyager Catalog format. Cube is a travel demand modeling software package developed by Citilabs and used by VDOT for the majority of the MPO regional travel demand models around the state. The Cube program provides a GIS-based user interface to create and evaluate transportation network alternatives. The program also provides an interface for alternative scenario development, editing, and model output review. The catalog structure within Cube uses outputs from the Richmond/Tri-Cities and Hampton Roads models and combines them with the inter-MPO model results to create a single superregional trip table and a single superregional network representative of the Richmond/Tri-Cities, Hampton Roads, and inter-MPO travel demand model study areas.

The trip table is a product of the trip distribution step in the travel demand modeling process by which the production trips are linked to attraction trips for each traffic analysis zone (TAZ) in the model. These productions and attractions are then balanced and distributed among the TAZ structure based on distance or travel times. The model assumes that the number of trips between two zones is 1) directly proportional to the trips produced and attracted to both zones, and 2) inversely proportional to the travel time between the zones.

The Route 460 corridor study area encompasses an approximate 16-mile stretch along the existing Route 460 alignment including approximately 11.5 miles of new four-lane limited access highway from west of Windsor in the west to the Route 58 Bypass/Route 460 interchange in the east. This section of Route 460 lies entirely within the Hampton Roads model, but since Route 460 provides an important link to the Richmond/Tri-Cities area, the superregional model was used to show the region-wide impacts.

The model was built for a base year of 2009 and a horizon year of 2034. However for this SEIS, the base year (existing) is 2013, the interim year (project opening) is 2021, and the design year is 2040. Therefore the superregional trip tables for 2009 and 2034 were interpolated to 2013 and 2021 and extrapolated to 2040 before assignment to the superregional network.

Figure 4-1: Tidewater Superregional Model Network



The focus of the model forecasting process centered on network development/modification to properly represent and assess the FHWA/VDOT Preferred Alternative. The results of this effort were used to prepare detailed traffic volume forecasts including daily and AM/PM peak hour volumes for both autos and trucks for the study intersections, ramps, and segments for 2021 and 2040. The traffic volume forecasts were then the basis for the completion of traffic operational analysis; the extraction/ organization of data to support the noise analysis (fifteen hours of traffic data reflecting total trucks per hour and percentage of trucks by vehicle classification); and AM and PM peak hour turning movement volumes and truck percentages for the air quality analysis.

It was determined for the No Build Alternative that the model network was consistent with both the Hampton Roads and Richmond/Tri-Cities MPO's Constrained Long Range Plans. However, there were several other projects in the Amended Hampton Roads Transportation Planning Organization (HRTPO) 2034 Long Range Transportation Plan (LRTP) that were also added to the model, as detailed in **Table 4-1**.

Table 4-1: Travel Demand Modeling Assumptions for Future Scenarios

	Project	HRTPO 2034 LRTP as Amended (Regionally Funded Construction Project)	Included in Route 460 No Build and Build Travel Demand Model Runs	
			Year 2021	Year 2040
1	I-64 Southside Widening (including High Rise Bridge)	Yes	No	Yes[2]
2	I-64 Peninsula Widening Segment I - Exit 255 to Exit 247	Yes	Yes	Yes
3	I-64 Peninsula Widening Segment II - Exit 247 to Exit 242	Yes	Yes	Yes
4	I-64 Peninsula Widening Segment III - Exit 242 to Exit 234	Yes	No[1]	Yes
5	I-64 Peninsula Interchange at Ft. Eustis Boulevard	Yes	No[1]	Yes
6	I-64/I-264 Interchange (including Witchduck Interchange)	Yes	Yes[1]	Yes
7	US Route 460/58/13 Connector including SPSA and Airport Interchanges	Yes	No	Yes
8	Patriots Crossing (with Craney Island Connector)	Yes	No	Yes

[1] Construction schedule currently unknown

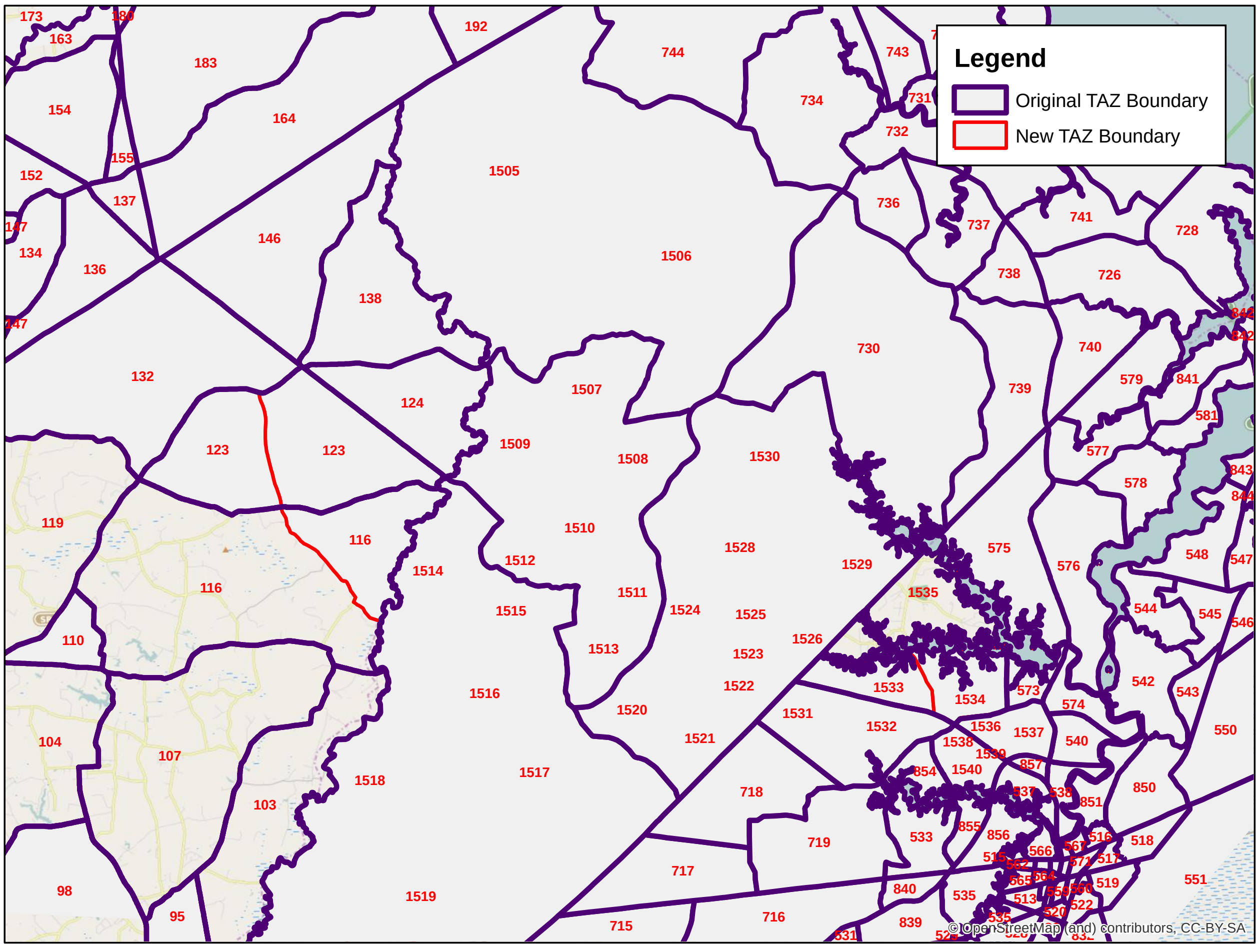
The modeling and forecasting effort for this study consisted of the following steps, each of which is described more fully in the sections that follow:

1. Network densification
2. Network checks and edits to reflect existing conditions
3. Alternatives network coding
4. Interpolation of 2009 and 2034 model output to develop 2021 and 2040 Design Year forecasts
5. Model output adjustments

4.2 TAZ SPLITING AND NETWORK DENSIFICATION

During the initial review of the model and its results, the resolution of the TAZs and network features in the Route 460 corridor was found to be too coarse for the level of forecasts needed for the project. Additional, more detailed TAZ and network data were determined to be necessary. Therefore, eight large TAZs in the study area were subdivided into 35 smaller TAZs. **Figure 4-2** shows the TAZ sizes before and after the subdivisions. Additional roadways were also coded into the model network to make it more dense and reflective of local traffic movements in certain areas. **Figure 4-3** shows the roadways that were added to the model network, including the FHWA/VDOT Preferred Alternative links.

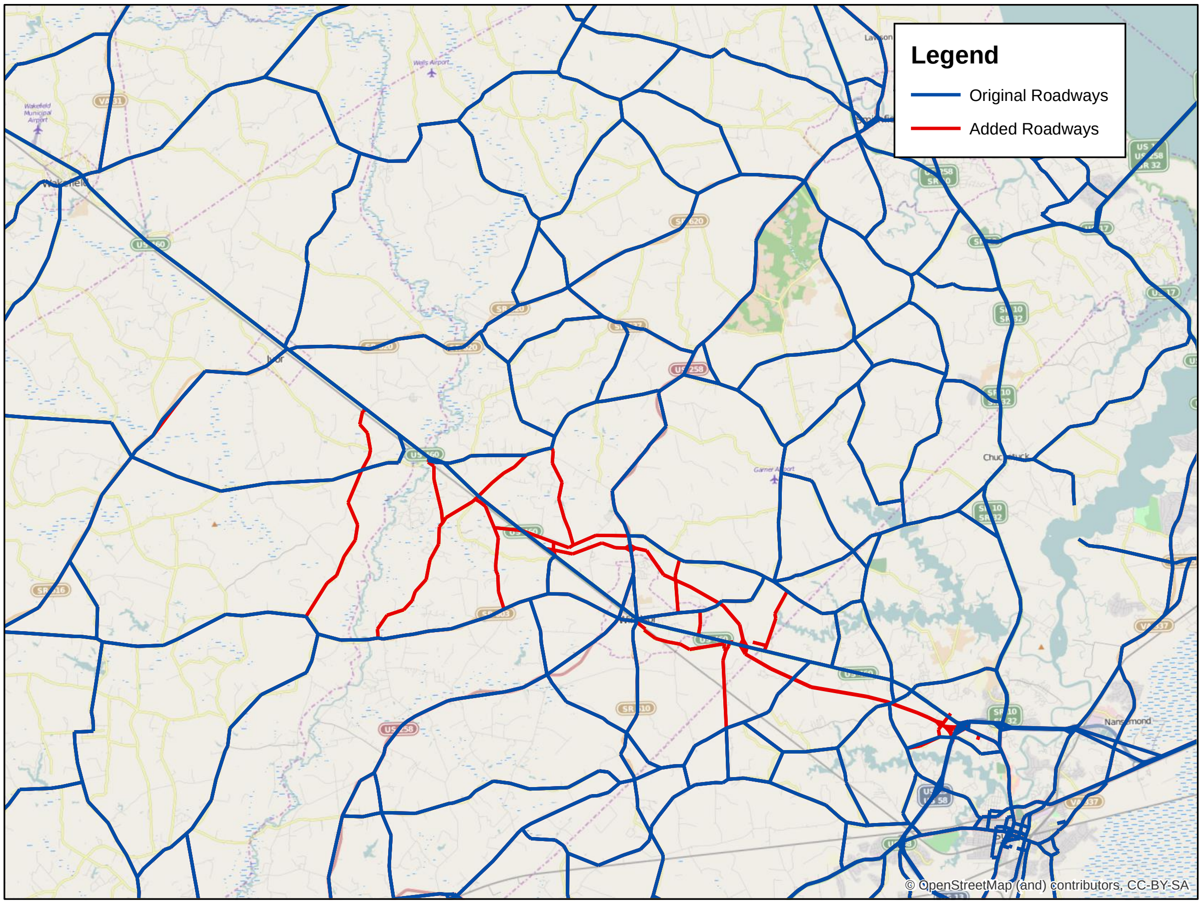
Figure 4-2: TAZ Modifications



After the TAZs were subdivided, the land use inputs (population and employment) were allocated to the new TAZ structure. For existing 2009 population inputs, 2010 census population counts by census block were used to perform the allocation. For the 2009 employment inputs, aerial photography was consulted to perform the allocation.

The 2034 demographic inputs were allocated to the new TAZs using multiple information sources. First, the land-use was compared to the 2009 allocation. Second, future land use plans were consulted for guidance as to where growth was planned, particularly for employment categories. Finally, the growth assumptions were checked against the available land area in each TAZ using aerial photography.

Figure 4-3: Roadway Modifications



4.3 NETWORK AND MODEL CHECKS

Validation of the base year results showed that the model was overestimating traffic in the Route 460 corridor. Investigation of the model flow found that the Hampton Roads model and the InterMPO model both estimated traffic on Route 460 with a reasonable degree of accuracy. However, that was primarily the result of hard-coded external station vehicle counts on the Route 460 external connection at the edge of the models.

When the superregional model merged the InterMPO model trips with the Hampton Roads model trips, the trips that crossed the external connectors between the two model areas needed to have their external end reallocated from the external connector to a TAZ in the adjoining model area. The merging process performed that allocation without consideration of the trip travel time or which external connector was used. This resulted in major adjustments to the trips moving from one model region to another. In the overall superregional model this did not have a significant impact. However, because the Route 460 corridor is at the edge of the Hampton Roads model area adjacent to the InterMPO model area it was greatly impacted by this model adjustment.

To address this issue, the merging process was modified in two ways. First, the process of redistributing external trip ends was changed so that trip ends in adjacent models would be joined together only if they used corresponding external connections in each model. Second, the distribution process was made sensitive to the travel time between trip ends, so that shorter trips were preferred. These modifications greatly improved the assignment of traffic in the Route 460 corridor, although the superregional model still overestimated volumes on Route 460 at the connection point between the two regional models.

A second possible cause of overestimation of traffic on Route 460 was found in the free flow speed that was assigned to each link based on facility and area types in the Hampton Roads model. The free flow speeds assigned to Route 460 itself were reasonable, except that they were too high in the towns that Route 460 passes through. The free flow speeds assigned to the other rural roads in the corridor were generally significantly below the posted speed limits for those roads. This would tend to cause more traffic to be assigned to Route 460 in preference to the adjacent rural roads because of the faster free flow speed. To address this, the free flow speed on each roadway link in the study corridor was hardcoded to the posted speed limit using the free flow override attribute.

Free flow speeds were also checked in the Route 460 corridor in the InterMPO model and were generally found to be acceptably close to the posted speed limits. Overall, these model adjustments lowered the traffic over-assignment from more than 100 percent to less than 40 percent for Route 460. The remaining traffic over-assignment was handled with post-model adjustments.

4.4 ALTERNATIVE NETWORK CODING

The Route 460 FHWA/VDOT Preferred Alternative was coded into the Hampton Roads model master network, using the Hampton Roads model project coding attributes. The New Route 460 alignment was coded as a freeway class road, with the interchange ramps coded as appropriate. The additional regional projects listed in **Table 4-1** above were also added to the same master network as their own individual projects.

The master network project function in the Hampton Roads model was then extended to allow specification of multiple projects added to a model scenario. This allowed No Build and Build scenarios for the various forecast years to be run from the same master network for consistency.

4.5 INTERPOLATION

Once coding was completed in the Hampton Roads model network, the process of running the model scenarios and creating the interpolated forecast year began. The basic process for running a model scenario was to run the Hampton Roads model for the alternative and then run the Tidewater model to merge the Hampton roads scenario results with the appropriate Richmond/Tri-Cities and InterMPO model results. This created a superregional model network and trip tables for the scenario, which was then processed through Cube's highway assignment model to create a final superregional traffic assignment.

Because the model's base year is 2009 and the future year is 2034, an interpolation process was used to create the 2013, 2021 and 2040 scenarios needed for this Final SEIS. The process started with the 2009 and 2034 superregional trip tables by time period and performed a straight-line interpolation/extrapolation to the desired forecast year on a cell-by-cell matrix for the entirety of the trip table matrices. **Table 4-2** describes the combination of inputs used to create each modeled scenario.

Table 4-2: Interpolated Model Scenario Inputs

Model Scenario	Interpolated Year 1	Interpolation Year 2	Network Year
2013 Existing	2009 No Build	2034 No Build	2009 No Build
2021 No Build	2009 No Build	2034 No Build	2018 No Build for HR, 2034 No Build for others
2021 Build	2009 Build	2034 Build	2018 Build for HR, 2034 No Build for others
2040 No Build	2009 No Build	2034 No Build	2034 No Build
2040 Build	2009 Build	2034 Build	2034 Build

4.6 TRAFFIC ASSIGNMENT OF ALTERNATIVES

Travel demand models are calibrated at a regional level to effectively represent major traffic flows at a broad scale, including overall traffic on major corridors. At the detailed level of the individual link, however, it is necessary to adjust model output to account for differences between the base year model output and actual traffic flows as determined from traffic counts. The basis for model adjustments is that if the base model over- or under-predicts existing traffic on a particular link, then the model is likely to over- or under-predict future traffic on the same link.

The methodology that was used in this study to adjust model output to reflect such differences is documented in National Cooperative Highway Research Program (NCHRP) Report 765. Report 765 presents two general methods for adjusting model outputs: the Ratio Method and the Difference Method.

1. The Ratio Method creates a future year turning movement forecast by applying the ratio of the future year model turning movement assignment to the base year model turning movement assignment and multiplying that by the base year turning movement count (NCHRP 765, 2014).
2. The Difference Method creates a future year turning movement forecast by applying the difference between the base year turning movement count and the base year model assignment to the future year model turning movement assignment (NCHRP 765, 2014).

Previously, the standard guidance was that these two methods should both be implemented and the average of the two results should be used. However, the NCHRP 765 guidance states that, “While averaging the results from the two methods may indeed reduce the extremes, it is also believed that averaging will reduce the accuracy of one method or the other. It is advised that the analyst evaluate the results from both methods within the context of existing traffic volumes and turning movements and select a preferred method.” This is the approach that was used for this project. Both methods were considered for each of the links and turning movements that was evaluated. Based on the results and in consideration of other localized factors (e.g., land-use, connectivity, implied annual growth) one of the two methods was selected and implemented. The 2013 balanced base year volumes were used in conjunction with the 2021 and 2040 No Build and Build volumes to perform these adjustments. On new facilities, model adjustments were made based on an examination of the detailed model data and based on the adjustments made to existing links that served the same general function. In some rare cases, a background percent growth was also considered for an existing link. This mainly applied where the model was clearly not providing reasonable outputs. Manual adjustments were also used to adjust turning movements where the model values needed to be adjusted and/or where adjustments were needed to balance flows between intersections.

The methods described above were used to develop the complete set of balanced daily AWDT, AM peak hour, and PM peak hour traffic volumes for both segments and intersections. The methods were applied to generate total traffic volumes as well as truck only traffic flows. Outputs from the Tidewater superregional model including the daily traffic model assignments, the AM and PM peak period traffic assignments, and the truck model assignments were all employed in the volume development process. Balancing the flows throughout the network was a major objective to yield a complete, consistent set of forecast volumes. The implied annual growth rates for the future volumes were also considered to inform the final forecast decisions.

Diurnal (hourly) volume distributions based on numerous counts in the study area were used to develop hourly flows for all analysis links. These hourly volumes were compared to the AM and PM peak hour volumes to make sure that the peak hour and daily/hourly volumes were consistent and balanced. These hourly volumes were subsequently used to develop the K factors and D factors needed for the environmental data.

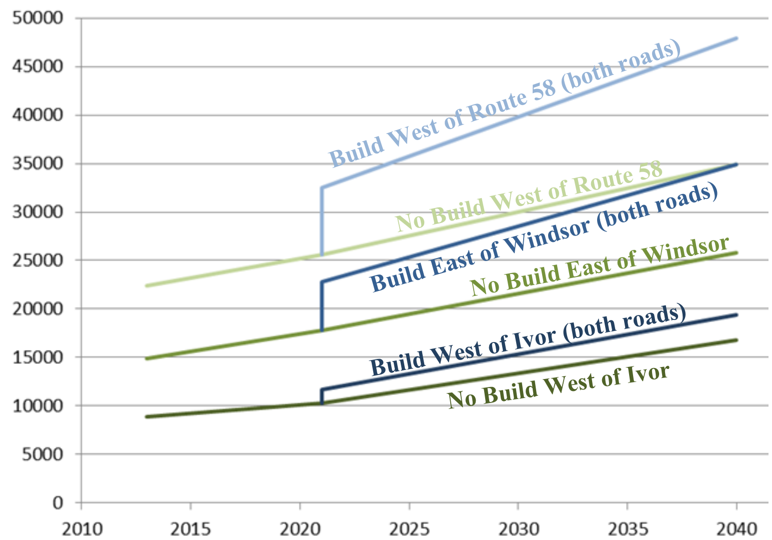
4.7 VOLUME FORECASTS

The Tidewater superregional model predicted substantial traffic growth in the Route 460 corridor and on several of the key side streets in the study area. This corridor traffic growth increased further with the addition of the FHWA/VDOT Preferred Alternative. The model output post-processing methods described above resulted in the volumes shown in **Table 4-3** and in **Figures 4-4** through **4-12**. The tables show the Route 460 volumes at five specific locations, highlighting the growth from the existing volume, while the figures show the volumes at the study intersections and ramps as well as several representative daily traffic locations.

Table 4-3: Route 460 Volumes and Percentage Increases from Existing

<table>
<tr><th></th><th colspan="2"></th><th>West of Ivor</th><th>West of Windsor</th><th>East of Windsor</th><th>East of Ex. Rt 460/New Rt 460</th><th>West of Route 58</th></tr>
<tr><td colspan="8">Traffic Volumes</td></tr>
<tr><td>Existing</td><td colspan="2">2013</td><td>8900</td><td>10100</td><td>14900</td><td>15100</td><td>22400</td></tr>
<tr><td rowspan="2">No Build Scenario</td><td colspan="2">2021</td><td>10300</td><td>12100</td><td>17800</td><td>18200</td><td>25600</td></tr>
<tr><td colspan="2">2040</td><td>16800</td><td>19400</td><td>25800</td><td>26400</td><td>34900</td></tr>
<tr><td rowspan="4">Build Scenario</td><td rowspan="2">2021</td><td>Existing 460</td><td>11700</td><td>2800</td><td>9200</td><td>4100</td><td>12500</td></tr>
<tr><td>New Route 460</td><td></td><td>13600</td><td>13600</td><td>21600</td><td>20000</td></tr>
<tr><td rowspan="2">2040</td><td>Existing 460</td><td>19400</td><td>5000</td><td>13300</td><td>8900</td><td>19300</td></tr>
<tr><td>New Route 460</td><td></td><td>21600</td><td>21600</td><td>31600</td><td>28600</td></tr>
<tr><td colspan="8">Increase Over Existing</td></tr>
<tr><td rowspan="2">No Build Scenario</td><td colspan="2">2021</td><td>1400</td><td>2000</td><td>2900</td><td>3100</td><td>3200</td></tr>
<tr><td colspan="2">2040</td><td>7900</td><td>9300</td><td>10900</td><td>11300</td><td>12500</td></tr>
<tr><td rowspan="2">Build Scenario</td><td colspan="2">2021 (both roads)</td><td>2800</td><td>6300</td><td>7900</td><td>10600</td><td>10100</td></tr>
<tr><td colspan="2">2040 (both roads)</td><td>10500</td><td>16500</td><td>20000</td><td>25400</td><td>25500</td></tr>
<tr><td colspan="8">Percent Change over Existing</td></tr>
<tr><td rowspan="2">No Build Scenario</td><td colspan="2">2021</td><td>16%</td><td>20%</td><td>19%</td><td>21%</td><td>14%</td></tr>
<tr><td colspan="2">2040</td><td>89%</td><td>92%</td><td>73%</td><td>75%</td><td>56%</td></tr>
<tr><td rowspan="2">Build Scenario</td><td colspan="2">2021 (both roads)</td><td>31%</td><td>62%</td><td>53%</td><td>70%</td><td>45%</td></tr>
<tr><td colspan="2">2040 (both roads)</td><td>118%</td><td>163%</td><td>134%</td><td>168%</td><td>114%</td></tr>
</table>

Figure 4-4: Route 460 Corridor Volumes: No Build and Build Comparison



Location	Year	No Build Scenario	Build Scenario (both roads)	Difference	Percent
West of Route 58	2021	25,600	32,500	6,900	27%
	2040	34,900	47,900	13,000	37%
East of Windsor	2021	17,800	22,800	5,000	28%
	2040	25,800	34,900	9,100	35%
West of Ivor	2021	10,300	11,700	1,400	14%
	2040	16,800	19,400	2,600	15%

Using the location east of Windsor as a representative location, in the No Build scenario the traffic volume on Route 460 is expected to increase from 14,900 in 2013 to 25,800 (+10,900) by 2040. With the FHWA/VDOT Preferred Alternative the volume on Route 460 (existing and new combined) in 2040 would be 34,900, which is 20,000 higher than existing conditions. This illustrates that the proposed project is forecasted to attract thousands of new vehicles to the corridor.

Considerable land-use growth is predicted within the study area over the next 20 years. This includes residential growth that will increase the number of households, but it also includes commercial and industrial growth. For example, there is a large industrial development area south of Windsor. The magnitude of the growth means that there will be more local traffic in the Windsor area. The growth in employment will also impact commuting patterns as there will be an increase in traffic headed west to jobs in the study area in the morning and returning east in the afternoon.

Figure 4-5: 2021 No Build Volumes

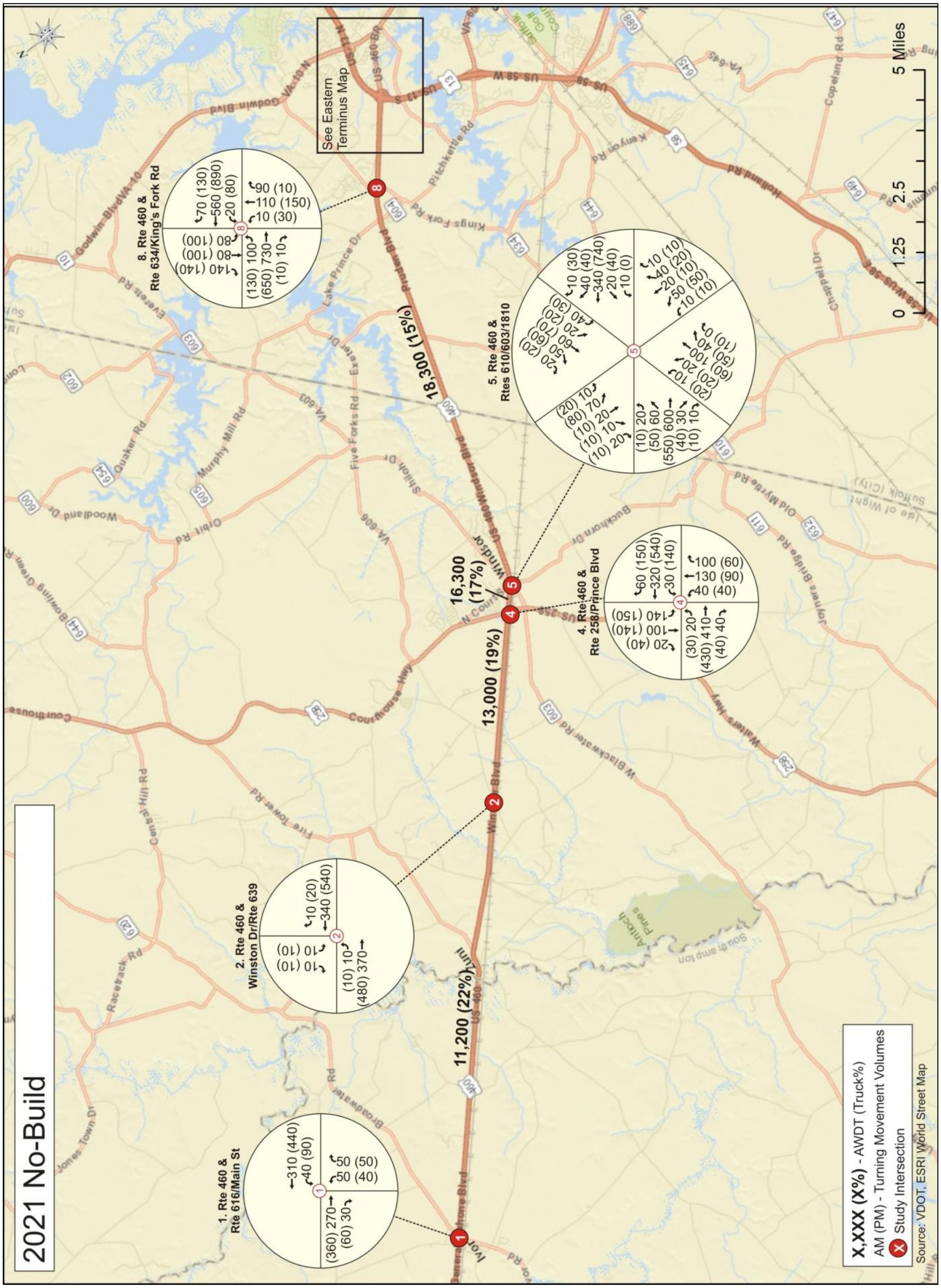


Figure 4-6: 2021 No Build Volumes – Eastern Terminus

Figure 4-7: 2021 Build Volumes

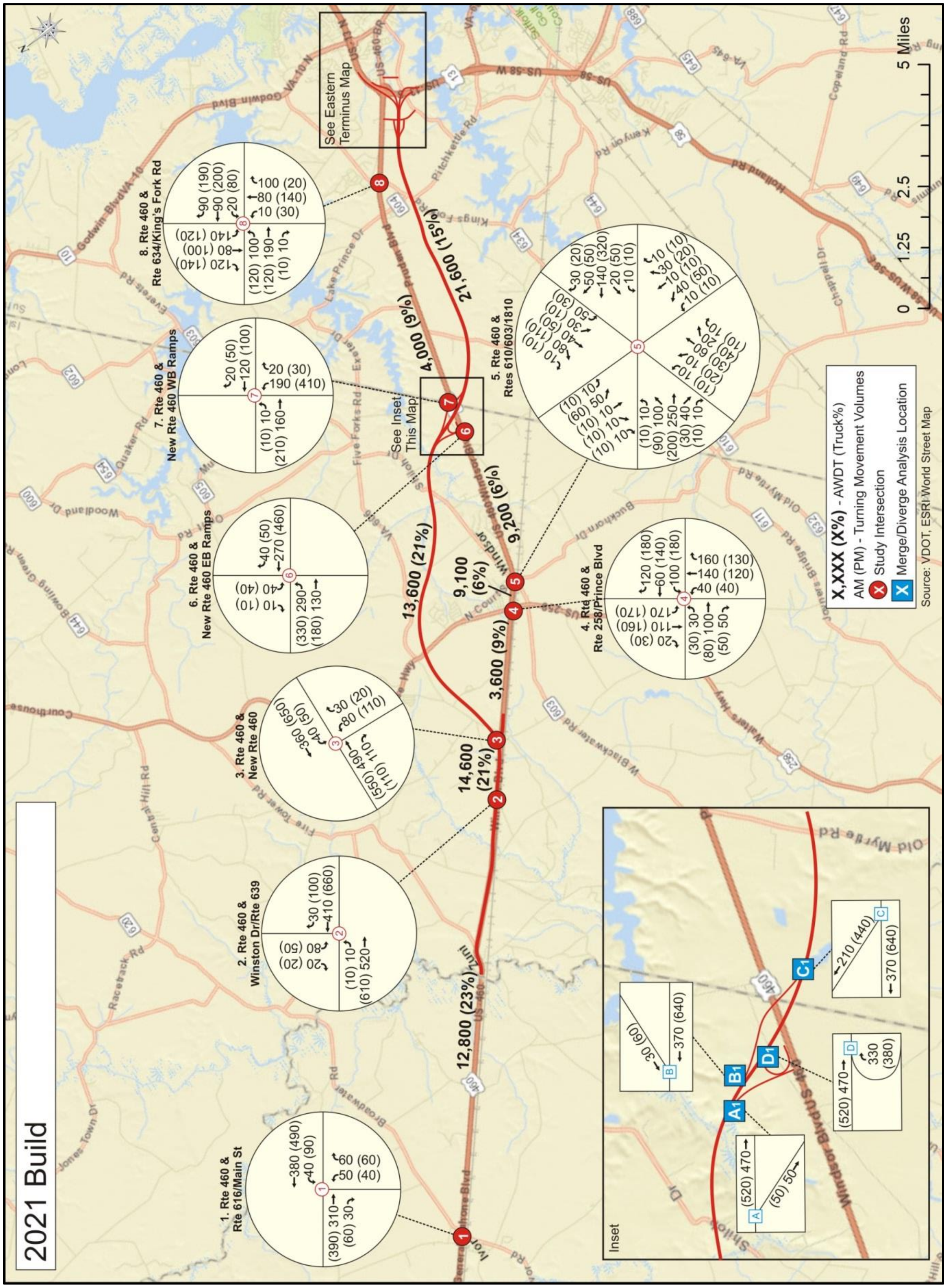


Figure 4-8: 2021 Build Volumes – Eastern Terminus

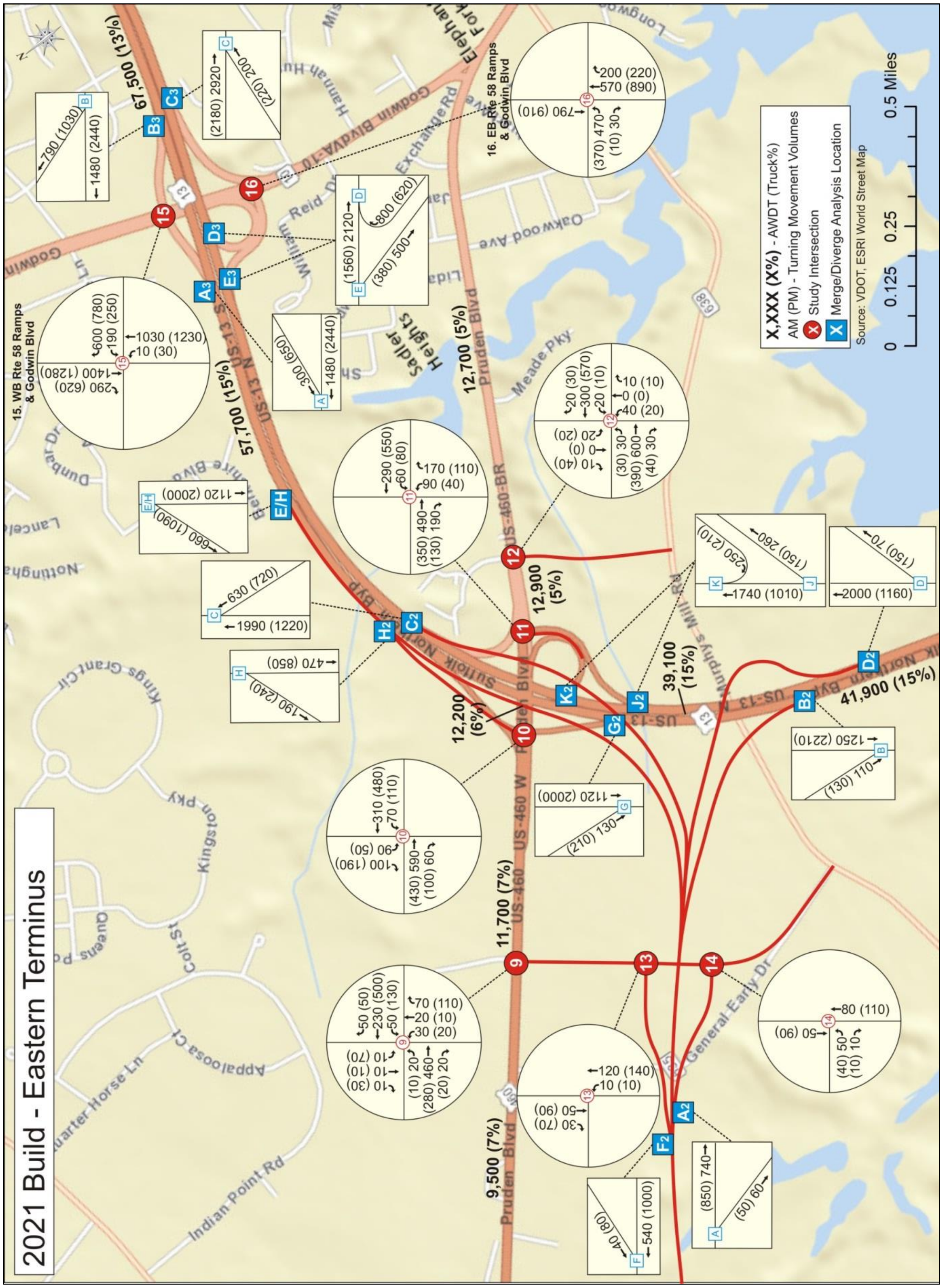


Figure 4-9: 2040 No Build Volumes

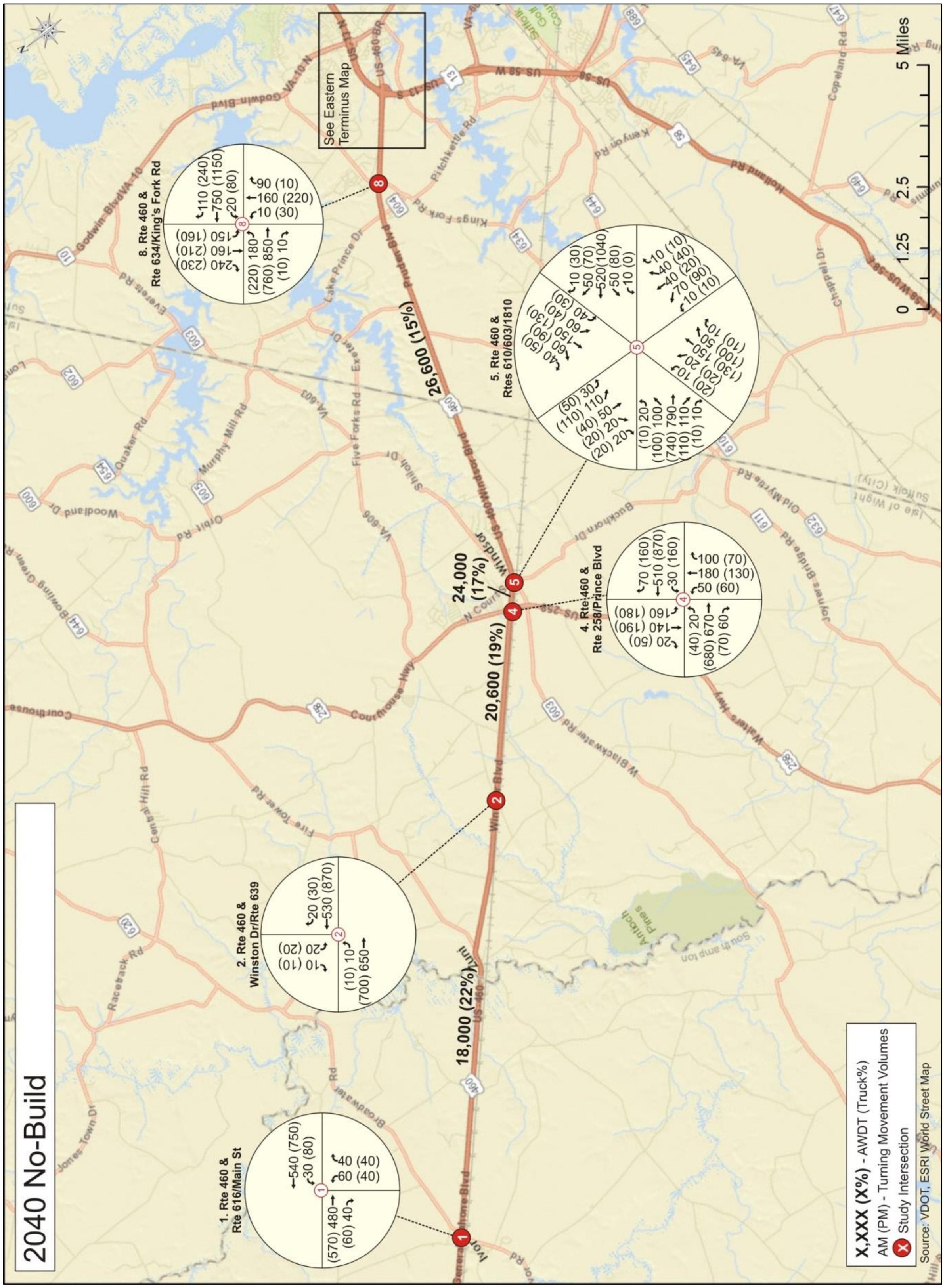


Figure 4-10: 2040 No Build Volumes – Eastern Terminus

Figure 4-11: 2040 Build Volumes

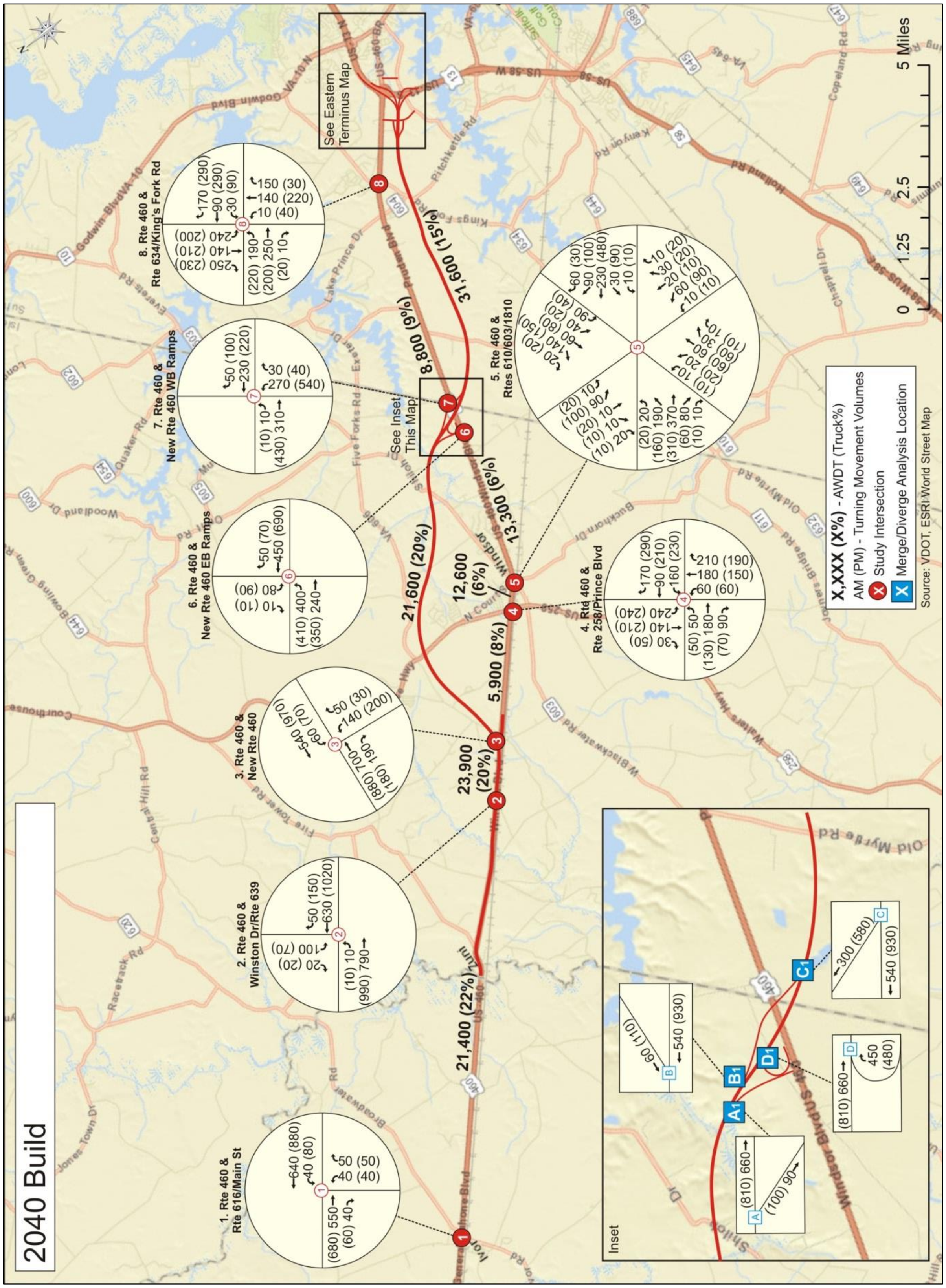
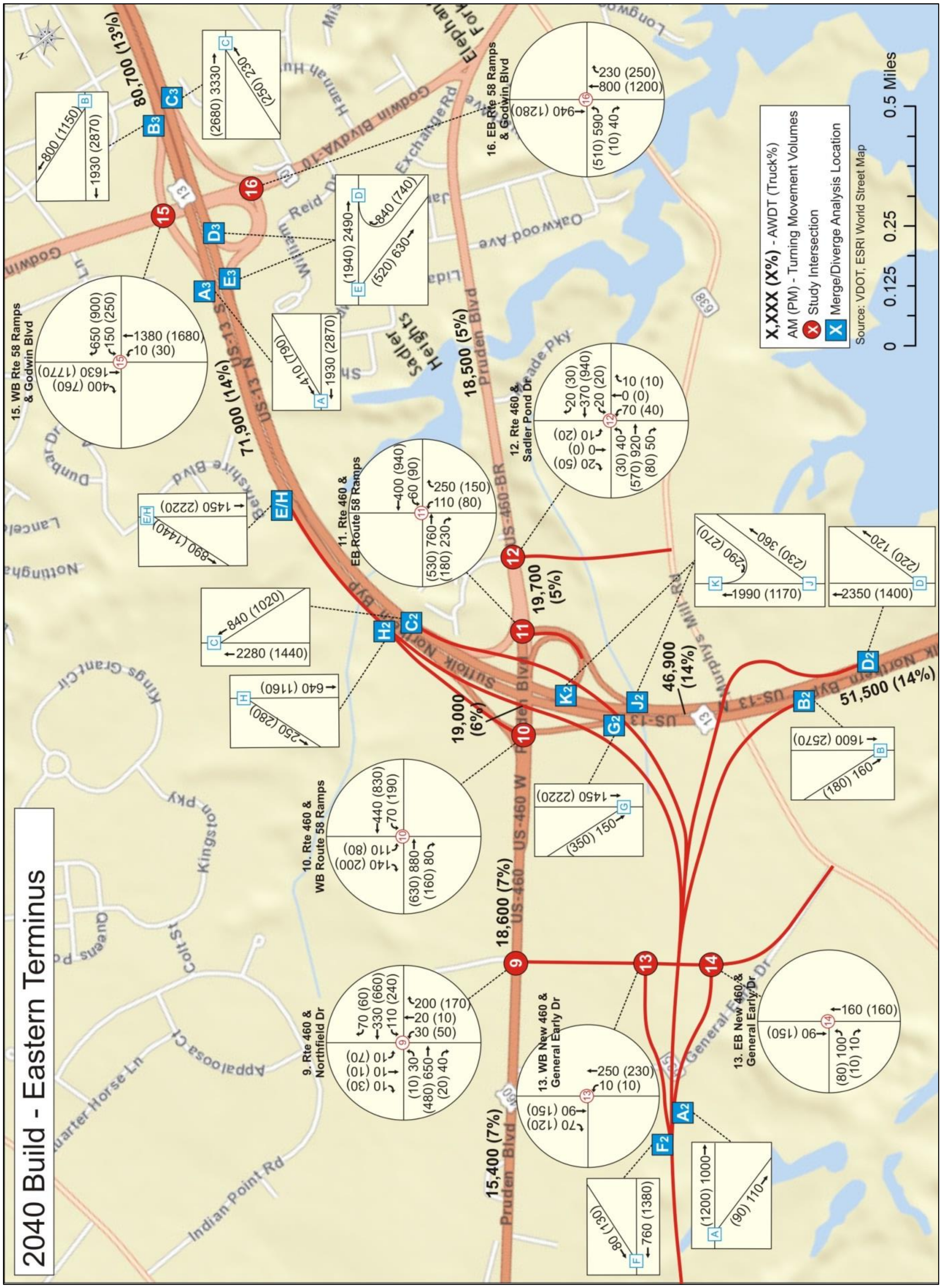


Figure 4-12: 2040 Build Volumes – Eastern Terminus



4.8 ENVIRONMENTAL TRAFFIC DATA

4.8.1 Noise Data

Input data required for the Environmental Traffic Data (ENTRADA) program used for the noise analysis include base year (2013) and design year (2040) ADT, hourly distribution of traffic volumes, directional distribution of traffic volumes, and proportion of medium trucks and heavy trucks. All of these data inputs were generated by the model post-processing discussed previously and were entered into ENTRADA. Other inputs, including number of lanes per direction, route type, median type, lateral clearance, lane width, access point density, posted speeds, and number of traffic signals, were collected and entered separately. The ENTRADA files are provided electronically in Appendix B.

4.8.2 Air Quality

As part of the air analyses, capacity analyses for the unsignalized and signalized intersections during the AM and PM peak hours were performed for each of the traffic volume scenarios:

- 2013 Existing Conditions
- 2021 Interim Year (project opening year) – No Build and Build
- 2040 Design Year – No Build and Build

The forecasted AM and PM projected traffic volumes were used for the capacity analyses. Analyses were completed to determine the operational characteristics of the mainline, new alignment, and Eastern Terminus study area signalized and unsignalized intersections using (S*ynchro Professional 9.0)*, which uses methodologies in the 2010 Highway Capacity Manual (HCM).

5.0 TRAFFIC OPERATIONS ANALYSIS

5.1 METHODOLOGY AND ASSUMPTIONS

The traffic operations analyses for the Existing (2013), Opening Year (2021) No Build and Build, and Design Year (2040) No Build and Build conditions were conducted to provide an evaluation of the FHWA/VDOT Preferred Alternative as presented in the ***Supplemental Alternatives Technical Report*** (VDOT, 2015x). The analysis was performed in accordance with *VDOT's Traffic Operations Analysis Tool Guidebook, Version 1.1 (TOATG).* Several operational characteristics were evaluated to quantify and qualify the operational performance of the FHWA/VDOT Preferred Alternative including level of service (LOS), travel times, vehicle miles traveled, and operating speeds.

The methodologies used and assumptions included in the evaluation of each of these performance measures are described below. Existing and forecasted traffic volumes and truck percentages as documented in the preceding sections were used for the analysis. In accordance with the TOATG, existing peak hour factors were used for the Existing conditions analysis. For future year analyses, if the existing peak hour factor (PHF) was higher than 0.92, it was used. Otherwise, a PHF of 0.92 was assumed. For Existing conditions, the number of lanes and lane widths were identified based on field measurements or aerial photography. For future conditions, the number of lanes and lane widths were based on the concept drawings for the FHWA/VDOT Preferred Alternative. The terrain was assumed to be level for grades of 0 to 2 percent and rolling for grades of 2 to 4 percent based on existing survey data and grade information associated with the FHWA/VDOT Preferred Alternative.

5.1.1 Traffic Operations Performance Measures

5.1.1.1 Signalized Intersections

Capacity analysis using Synchro was performed at signalized intersections within the study area for Existing (2013), Opening Year (2021), and Design Year (2040) conditions. Intersection geometry and traffic control device configurations were identified based on documentation from field visits and/or aerial photography. Signal timing data were provided by VDOT. The existing traffic signal cycle lengths and timings were not modified for the Existing conditions analysis; however, for the future Design Year (2040) conditions, traffic signal cycle lengths were modified where necessary and signal splits were adjusted to provide optimized signal timings. It can be reasonably anticipated that traffic signal timings will be adjusted in the future to accommodate varying travel demands. Intersection LOS outputs were obtained from Synchro using the HCM 2000 Signals report, which follows the procedures outlined in the HCM. **Table 5-1** defines LOS A through F for signalized intersections.

Table 5-1: Signalized Intersection LOS Descriptions

LOS	Description	Delay (sec/veh)	Congestion Level
A	Progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values.	≤ 10	Low
B	Good progression with short cycle lengths. Some vehicle stoppage may occur, causing slightly higher levels of delay.	> 10 – 20	Low
C	Higher delays resulting from fair progression, longer cycle lengths, or both. Individual cycle failure may begin to occur at this level, resulting in some overflow. The number of vehicles stopping is significant at this level, but many still pass through the intersection without stopping.	> 20 – 35	Moderate
D	Longer delays may result from some combination of unfavorable progression, long cycle lengths, and lane flow rates conflicting with signal timing. Individual cycle failures are noticeable at this level.	>35 – 55	Moderate
E	High delay level indicative of poor progression, long cycle lengths, and high ratios of conflicts between lane flow rates and signal timing. Individual cycle failures are frequent.	>55 – 80	Severe
F	Arrival flow rates exceed the capacity of lane groups and conflicting signal timing. Evidenced by poor progression and long cycle lengths with many individual cycle failures. Considered to be unacceptable by most motorists.	> 80	Severe

Source: *Highway Capacity Manual*, Transportation Research Board, 2010, pp. 18-6.

5.1.1.2 Unsignalized Intersections

Capacity analysis using Synchro was performed at the unsignalized intersections within the study area for Existing (2013), Opening Year (2021), and Design Year (2040) conditions. Intersection geometry and traffic control device configurations (i.e., two-way STOP controlled (TWSC) or STOP controlled for one approach) were identified based on documentation from field visits and/or aerial photography. LOS outputs were obtained from Synchro using the HCM 2000 Unsignalized report, which follows the procedures outlined in the HCM. **Table 5-2** defines LOS A through F for approaches at unsignalized intersections. The movement with the greatest amount of delay is reported as the delay and LOS of an unsignalized intersection.

Table 5-2: Unsignalized Intersection Approach/Movement LOS Descriptions

LOS	Description	Delay (sec/veh)	Congestion Level
A	Very low delay, progression is extremely favorable.	≤ 10	Low
B	Generally good progression, low delays.	> 10 – 15	Low
C	Fair progression, increasing number of vehicles must stop.	> 15 – 25	Moderate
D	Traffic congestion more noticeable, unfavorable congestion and longer delays.	> 25 – 35	Moderate
E	Poor progression, generally high volume to capacity ratios, intersection traffic approaching capacity.	> 35 – 50	Severe
F	Unacceptable conditions, arrival flow exceeds intersection capacity, poor progression, and high delays	> 50	Severe

Source: *Highway Capacity Manual*, Transportation Research Board, 2010 pp. 19-2.

5.1.1.3 Roadway Segments

Multilane roadway segments with signalized intersections spaced at greater than two miles are considered multilane highways. This is consistent with the 2010 HCM Chapter 14, Multilane Highways. Analyses were conducted using the 2010 Highway Capacity Software (HCS), which implements the HCM procedures and methodologies. Both directions of travel along Route 460 were evaluated for each multilane highway segment within the study area. In accordance with the TOATG, for roadway segments where field data were not available, a free flow speed (FFS) equal to the posted speed limit plus 7 mph was used. In HCS, the allowable multilane segment FFS is 45 to 65 mph. Therefore, a FFS of 45 mph was assumed for speeds less than 45 mph and a FFS of 65 mph was assumed for speeds greater than 65 mph.

The capacity of a multilane highway segment varies with the free-flow speed and the LOS is defined on the basis of density, which is expressed in passenger cars per mile per lane (pc/mi/ln). **Table 5-3** defines LOS A through F for the multilane segment.

Table 5-3: Multilane Highway Segment LOS Descriptions

LOS	Free Flow Speed (MPH)	Density (pc/mi/ln)	Congestion Level
A	All	> 0-11	Low
B	All	> 11-18	Low
C	All	> 18-26	Moderate
D	All	> 26-35	Moderate
E	60 55 50 45	> 35-40 > 35-41 > 35-43 > 35-45	Severe
F	Demand Exceeds Capacity 60 55 50 45	Demand Exceeds Capacity > 40 > 41 > 43 > 45	Severe

Source: *Highway Capacity Manual*, Transportation Research Board, 2010, pp. 14-4.

5.1.1.4 Freeway Segments

Freeway segments for the study area were defined as access-controlled facilities with two or more lanes of traffic in each direction. LOS for freeways within the study area was derived based on HCM methodologies that calculate the density (passenger car per mile per lane (pc/mi/ln)) for the analysis segments. In accordance with the TOATG, for roadway segments where field data were not available, a FFS equal to the posted speed limit plus 7 mph was used. The maximum allowable freeway FFS in HCS is 75 mph. Therefore, for freeway segments with a posted speed of 70 mph (which would result in a FFS of 77 mph), a FFS of 75 mph was assumed. Capacity analyses were conducted using the 2010 HCS, which implements the HCM procedures and methodologies. **Table 5-4** defines LOS A through F for the freeway segments.

Table 5-4: Freeway Segment LOS Descriptions

LOS	Description	Density (pc/mi/ln)	Congestion Level
A	Free-flow operations. Free flow speed prevails on the freeway and vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The effects of incidents or point breakdowns are easily absorbed.	≤ 11	Low
B	Reasonable free-flow operation and free flow speed on the freeway is maintained. The ability to maneuver within the traffic stream is only slightly restricted and the general level of physical and psychological comfort provided to drivers is still high. The effect of minor incidents and point breakdowns are still easily absorbed.	> 11-18	Low
C	Provides for flow with speeds near the free flow speed of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted and lane changes require more care and vigilance on the part of the driver. Minor incidents may still be absorbed, but the local deterioration in service quality will be significant.	> 18-26	Moderate
D	The level at which speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to maneuver within the traffic stream is seriously limited and drivers experience reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing because the traffic stream has little space to absorb disruptions.	> 26-35	Moderate
E	Operation at capacity. Operations on the freeway at this level are highly volatile because there are virtually no usable gaps within the traffic stream, leaving little room to maneuver within the traffic stream. Any disruption to the traffic stream can establish a disruption wave that propagates throughout the upstream traffic flow. The traffic stream has no ability to dissipate even the most minor disruption, and any incident can be expected to produce a serious breakdown and substantial queuing. The physical and psychological comfort afforded to drivers is poor.	> 35-45	Severe
F	Breakdown or unstable flow. Demand exceeds the capacity of the facility.	> 45	Severe

Source: *Highway Capacity Manual*, Transportation Research Board, 2010, pp. 11-6.

5.1.1.5 Ramp Merges/Diverges

Ramp merge and diverge junctions along freeways at the interchanges within the study area were analyzed based on HCM methodologies that calculate the density (passenger car per mile per lane (pc/mi/ln)) for the analysis segments. Acceleration and deceleration lengths were based on field measurements and/or the interchange concept drawings associated with the FHWA/VDOT Preferred Alternative.

In areas where two major roadways or ramps diverge (major diverge areas), the capacities of entering and departing roadways were checked in accordance with Equation 13-1 and Exhibit 13-10 of the HCM 2010 to confirm that volumes do not exceed capacity (i.e., volume-to-capacity ratio is less than 1.0). LOS was computed using Equation 13-26 and the criteria of Exhibit 13-2 to determine a LOS for the major diverge influence areas.

In areas where two major roadways or ramps are merging (major merge areas), the capacities of entering and departing roadways were checked in accordance with Equation 13-1 and Exhibit 13-10 of the HCM 2010 to confirm that volumes do not exceed capacity (i.e., volume-to-capacity ratio is less than 1.0). Per the HCM 2010, LOS cannot be determined for major merge areas. It is acknowledged that major merge areas are defined as where two primary roads, each having multiple lanes join to form a single freeway segment; however, the major merge areas identified within the Eastern Terminus consist of two single lanes joining to form a two-lane roadway segment. Due to the limitations of the HCM 2010, these junctions were treated as major merge areas. **Table 5-5** defines LOS A through F for the ramp merges and diverges.

Table 5-5: Ramp Merge/Diverge Segment LOS Descriptions

LOS	Description	Density (pc/mi/ln)	Congestion Level
A	Unrestricted operations	≤10	Low
B	Merging and diverging maneuvers noticeable to drivers	>10-20	Low
C	Influence area speeds begin to decline	>20-28	Moderate
D	Influence area turbulence becomes intrusive	>28-35	Moderate
E	Turbulence felt by virtually all drivers	>35	Severe
F	Ramp and freeway queues form	Demand exceeds capacity	Severe

Source: *Highway Capacity Manual 2000,* Transportation Research Board, 2010, pp.13-4.

5.1.1.6 Ramp Segments

The four flyover ramp segments included in the Eastern Terminus serving Route 58 and New Route 460 were analyzed using HCM methodologies. To determine the operational characteristics of the ramps, volume-to-capacity (V/C) ratios were calculated based on HCM methodologies. Using these methodologies, the demand flow rate and ramp capacities were determined. The demand flow rates for the ramps were calculated using Equation 13-1 of the 2010 HCM and the ramp capacity was based on Exhibit 13-10 of the 2010 HCM. In accordance with the TOATG, a FFS equal to the design/warning speed plus 10 mph was assumed. The freeway FFS was determined using the methods as described in the previous section. The resulting V/C ratios were converted to LOS based on the ranges described in **Table 5-6**.

Table 5-6: Ramp Segment LOS Descriptions Based on V/C Ratios

Volume-to-Capacity (V/C) Ratio	LOS	Congestion Level
0.00 to 0.29	A	Low
0.291 to 0.47	B	Low
0.471 to 0.68	C	Moderate
0.681 to 0.88	D	Moderate
0.881 to 1.00	E	Severe
Greater than 1.00	F	Severe

Source: *Highway Capacity Manual 2000 – LOS Criteria for Basic Freeway Segments FFS=60 mi/h*, TRB, 2000, pp.23-4.

5.2 LEVEL OF SERVICE ANALYSIS SUMMARY

LOS was summarized for Existing (2013), Opening Year (2021) No Build and Build, and Design Year (2040) No Build and Build conditions for the various roadway elements summarized above. **Table 5-7** presents LOS for the study area excluding the Eastern Terminus. **Table 5-8** presents LOS for the Eastern Terminus and the Route 58 at Route 10/Godwin Boulevard interchange which was summarized independently from the remainder of the corridor due to its complexity and the various features that differ from the remainder of the study corridor (i.e., freeway operations). An analysis of the Route 58 at Godwin Boulevard interchange was performed to determine the impact of the FHWA/VDOT Preferred Alternative and associated traffic volumes on operations at this adjacent interchange. It should be noted that some locations do not exist under either Existing/No Build or Build conditions due to changes associated with the FHWA/VDOT Preferred Alternative. Blank cells in the table indicate those non-existent intersections for a particular scenario. The Synchro/HCS files are provided electronically in Appendix C.

Table 5-7: Route 460 Level of Service Summary

Location	Existing			No Build					Build				
		2013			2021		2040			2021		2040	
	Facility Type	AM Peak	PM Peak	Facility Type	AM Peak	PM Peak	AM Peak	PM Peak	Facility Type	AM Peak	PM Peak	AM Peak	PM Peak
Roadway Segments													
EB Route 460 between Main St and new Route 460 improvements	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
WB Route 460 between Main St and new Route 460 improvements	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
EB Route 460 between new Route 460 improvements and Town of Zuni	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
WB Route 460 between new Route 460 improvements and Town of Zuni	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
EB Route 460 in Town of Zuni	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	B
WB Route 460 in Town of Zuni	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	B
EB Route 460 between Town of Zuni and Cut Thru Rd	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
WB Route 460 between Town of Zuni and Cut Thru Rd	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	B
EB Route 460 between Cut Thru Rd and Route 258/Prince Blvd	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
WB Route 460 between Cut Thru Rd and Route 258/Prince Blvd	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
EB Route 460 between Court St/ Church St/ Bank St and Ennis Mill Rd/ New Route 460 Interchange	Multilane Segment	A	A	Multilane Segment	A	A	A	A	Multilane Segment	A	A	A	A
WB Route 460 between Court St/ Church St/ Bank St and Ennis Mill Rd/ New Route 460 Interchange	Multilane Segment	A	A	Multilane Segment	A	A	A	B	Multilane Segment	A	A	A	A
EB Route 460 between Ennis Mill Rd/ New Route 460 Interchange and Kings Fork Rd	Multilane Segment	A	A	Multilane Segment	A	A	B	B	Multilane Segment	A	A	A	A
WB Route 460 between Ennis Mill Rd/ New Route 460 Interchange and Kings Fork Rd	Multilane Segment	A	A	Multilane Segment	A	B	B	B	Multilane Segment	A	A	A	A
EB New Route 460 between Green-T intersection and Route 460 interchange									Freeway Segment	A	A	A	A
WB New Route 460 between Green-T intersection and Route 460 interchange									Freeway Segment	A	A	A	A
EB New Route 460 west of General Early Dr									Freeway Segment	A	A	A	A
WB New Route 460 west of General Early Dr									Freeway Segment	A	A	A	B
Merge/Diverge Junctions													
EB New Route 460 off-ramp to Existing Route 460									Ramp A_1 Diverge	A	A	B	B
Existing Route 460 on-ramp to EB New Route 460									Ramp D_1 Merge	A	A	A	A
WB New Route 460 off-ramp to Existing Route 460									Ramp C_1 Diverge	A	B	B	B
Existing Route 460 on-ramp to WB New Route 460									Ramp B_1 Merge	A	A	A	A
Intersections (2)													
1 Route 460 at Route 616/Main Street	Signalized	B	B	Signalized	A	A	A	A	Signalized	A	A	A	A
2 Route 460 at Winston Dr/ Route 639	Unsignalized	B	B	Unsignalized	B	B	C	D	Unsignalized	B	C	C	D
3 Existing Route 460 at New Route 460 (Green-T)									Signalized	A	A	A	A
4 Existing Route 460 at Route 258/ Prince Blvd	Signalized	D	D	Signalized	D	D	D	E	Signalized	D	D	D	E
5 Existing Route 460 at Routes 610/603/1810	Signalized	E	D	Signalized	D	D	F	F	Signalized	C	D	E	E
6 Existing Route 460 at EB New Route 460 ramps									Signalized	A	B	B	B
7 Existing Route 460 at WB New Route 460 ramps									Signalized	B	C	B	C
8 Route 460 at Route 634/Kings Fork Rd	Signalized	C	C	Signalized	B	C	D	D	Signalized	C	B	C	C
EB New Route 460 west of General Early Dr									Freeway Segment	A	A	A	A
WB New Route 460 west of General Early Dr									Freeway Segment	A	A	A	B
EB New Route 460 between General Early Dr ramps and Route 58 ramps									Freeway Segment	A	A	A	A
WB New Route 460 between General Early Dr ramps and Route 58 ramps									Freeway Segment	A	A	A	B

Notes:
(1) Traffic analysis performed in accordance with the *Highway Capacity Manual 2010* and the *VDOT Traffic Analysis Tool Guidebook Version 1.1*
(2) For unsignalized intersections, the LOS reported is for the movement with the worst LOS

Legend: Level of Service	
(green)	LOS C or better
(yellow)	LOS D
(orange)	LOS E
(red)	LOS F

Table 5-8: Eastern Terminus Level of Service Summary

Location	Existing			No Build					Build				
	Facility Type	2013		Facility Type	2021		2040		Facility Type	2021		2040	
		AM Peak	PM Peak		AM Peak	PM Peak	AM Peak	PM Peak		AM Peak	PM Peak	AM Peak	PM Peak
Freeway Segments													
EB Route 58 west of New Route 460	Freeway Segment	B	B	Freeway Segment	B	B	C	B	Freeway Segment	B	B	C	B
WB Route 58 west of New Route 460	Freeway Segment	A	C	Freeway Segment	B	C	B	C	Freeway Segment	B	C	B	C
EB Route 58 between Route 460 and Godwin Blvd	Freeway Segment	C	B	Freeway Segment	C	B	C	B	Freeway Segment	C	B	D	C
WB Route 58 between Route 460 and Godwin Blvd	Freeway Segment	B	C	Freeway Segment	B	C	B	D	Freeway Segment	B	D	C	D
EB Route 58 east of Godwin Blvd	Freeway Segment	C	B	Freeway Segment	C	C	D	C	Freeway Segment	C	C	D	C
WB Route 58 east of Godwin Blvd	Freeway Segment	C	D	Freeway Segment	C	D	C	E	Freeway Segment	C	D	C	E
Merge/Diverge Junctions													
EB New Route 460 Off-Ramp to General Early Dr									Ramp A_2 Diverge	A	A	B	B
EB New Route 460 On-Ramp to EB Route 58									Ramp B_2 Merge	C	B	C	C
EB New Route 460 Diverge to EB and WB Route 58									Ramp B_2 and C_2 Major Diverge (2)	A	A	B	B
EB New Route 460 On-Ramp to WB Route 58									Ramp C_2 Merge	B	C	B	C
EB Route 58 Off-Ramp to WB New Route 460									Ramp D_2 Diverge	B	B	C	B
EB and WB Route 58 Ramps to WB New Route 460 Merge									Ramp D_2 and E_2 Major Merge	(2)	(2)	(2)	(2)
WB Route 58 Off-Ramp to New and/or Existing Route 460	Ramp H_2 Diverge	B	C	Ramp H_2 Diverge	B	C	B	D	Ramp E/H Two-Lane Diverge	A	A	A	B
General Early Dr On-Ramp to WB New Route 460									Ramp F_2 Merge	A	A	A	B
Existing EB Route 460 On-Ramp to EB Route 58	Ramp K_2 Merge	B	B	Ramp K_2 Merge	C	B	C	B	Ramp K_2 Merge	B	B	B	B
Existing Route 460 On-Ramp to WB Route 58	Ramp G_2 Merge	B	C	Ramp G_2 Merge	B	C	B	C	Ramp G_2 Merge	B	C	B	C
EB Route 58 Off-Ramp to Existing Route 460	Ramp J_2 Diverge	B	B	Ramp J_2 Diverge	B	B	C	B	Ramp J_2 Diverge	B	B	C	B
Existing WB Route 460 On-Ramp to EB Route 58	Ramp L_2 Merge	C	B	Ramp L_2 Merge	C	B	C	B					
WB Route 58 Off-Ramp to Godwin Blvd	Ramp B_3 Diverge	C	D	Ramp B_3 Diverge	C	D	C	E	Ramp B_3 Diverge	C	D	D	E
Godwin Blvd On-Ramp to WB Route 58	Ramp A_3 Merge	B	C	Ramp A_3 Merge	B	C	C	D	Ramp A_3 Merge	B	D	C	D
EB Route 58 Off-Ramp to Godwin Blvd	Ramp E_3 Diverge	C	B	Ramp E_3 Diverge	C	B	C	C	Ramp E_3 Diverge	C	B	D	C
SB Godwin Blvd On-Ramp to EB Route 58	Ramp D_3Merge	C	B	Ramp D_3Merge	C	B	C	C	Ramp D_3Merge	C	B	D	C
NB Godwin Blvd On-Ramp to EB Route 58	Ramp C_3 Merge	C	B	Ramp C_3 Merge	C	B	D	C	Ramp C_3 Merge	C	C	D	C
Ramp Capacities													
EB New Route 460 On-Ramp to EB Route 58									Ramp B_2	B	B	C	C
EB New Route 460 On-Ramp to WB Route 58									Ramp C_2	A	A	A	A
EB Route 58 Off-Ramp to WB New Route 460									Ramp D_2	A	A	A	A
WB Route 58 Off-Ramp to WB New Route 460									Ramp E_2	B	C	B	C
Intersections (3)													
9 Existing Route 460 at Relocated General Early Dr/Northfield Dr	Signalized	A	A	Signalized	A	A	A	A	Signalized	B	B	B	C
10 Existing Route 460 at WB Route 58 Ramps	Unsignalized (4)	C	E	Signalized (4)	A	A	A	A	Signalized (4)	A	A	A	A
11 Existing Route 460 at EB Route 58 Ramps	Signalized	B	A	Signalized	C	B	C	C	Signalized	B	A	B	A
12 Existing Route 460 at Sadler Pond Dr/Murphy's Mill Connector	Unsignalized	B	B	Unsignalized	B	C	C	D	Unsignalized (5)	C	C	F	F
13 General Early Dr at WB New Route 460									Unsignalized	A	A	A	A
14 General Early Dr at EB New Route 460									Unsignalized	A	A	B	B
15 WB Route 58 ramps at Godwin Blvd	Signalized	D	D	Signalized	C	C	D	D	Signalized	C	C	C	D
16 EB Route 58 ramps at Godwin Blvd	Signalized	B	B	Signalized	B	B	D	C	Signalized	B	B	C	C

Notes:
(1) Traffic analysis performed in accordance with the *Highway Capacity Manual 2010* and the *VDOT Traffic Analysis Tool Guidebook Version 1.1*
(2) Per the HCM 2010, the capacities of all entering and departure segments have been checked to confirm that volumes do not exceed capacity
(3) For unsignalized intersections, the LOS reported is for the movement with the worst LOS
(4) Intersection currently operates unsignalized but is assumed to be signalized in the future pending assessment of signal warrants
(5) Intersection currently operates unsignalized; installation of a traffic signal (when warranted) will address the LOS deficiency; however, the volumes on the minor street approaches that are causing the LOS deficiency are relatively low (less than 100 vehicles per hour in the AM and PM peak hours) and a traffic signal is not likely to be warranted.

Legend: Level of Service	
(green)	LOS C or better
(yellow)	LOS D
(orange)	LOS E
(red)	LOS F

5.3 LEVEL OF SERVICE ANALYSIS OF EXISTING CONDITIONS

5.3.1 Intersections

LOS at the study intersections along Route 460 are variable throughout the corridor with poor LOS at the two study signalized intersections located in Windsor. Specifically, the Route 460 at Route 258/Prince Boulevard intersection operates at LOS D during both the AM and PM peak hours. This can be primarily attributed to heavy turning volumes between Route 258 and Route 460 to the east of the intersection. The Route 460 at Route 610/603/1810 intersection operates at LOS E during the AM peak hour and LOS D during the PM peak hour. This is partially due to the six-legged intersection configuration and the inefficiencies created by this type of operation, which results in significant lost time due to the time required to serve all of the signal phases. The remaining study area intersections along Route 460 operate at LOS C or better.

5.3.2 Roadway Segments

All roadway segments along Route 460 operate at LOS A or B under existing conditions.

5.3.3 Route 58 at Route 460 and Route 10/Godwin Boulevard Interchanges

Heavy traffic volumes along Route 58 and turning movements at the Route 460 and Route 10/Godwin Boulevard interchanges contribute to poor LOS in this area where greater growth and development have occurred. The westbound Route 58 freeway segment east of the Route 10/Godwin Boulevard interchange, the diverge from westbound Route 58 to Route 10/Godwin Boulevard, and the intersection of Route 10/Godwin Boulevard with the westbound Route 58 ramps operate at LOS D during the PM peak hour. The westbound segment of Route 58 east of Route 10/Godwin Boulevard has the highest traffic volumes along Route 58 within the study area during the PM peak hour, contributing to the poor LOS.

At the Route 58 and Route 460 interchange, the westbound Route 58 off-ramp unsignalized intersection with Route 460 operates at LOS E during the PM peak hour, specifically the left turn from the ramp to eastbound Route 460. This is caused by a lack of sufficient gaps in traffic along Route 460.

The remaining study area intersections, roadway segments, and ramps in the vicinity of the existing interchanges operate at LOS C or better.

5.4 ANALYSIS OF NO BUILD CONDITIONS

The No Build Alternative assumes that existing roadways within the study area remain as is in both 2021 (Opening Year) and 2040 (Design Year) with one exception. Planned improvements at the intersection of the westbound Route 58 off-ramp at Route 10/Godwin Boulevard will consist of the construction of a second exclusive right turn lane on the ramp approach to the intersection. Capacity analyses were performed using the forecasted traffic volumes and truck percentages for each analysis year.

5.4.1 Intersections

As traffic volumes increase in the future, LOS at the study intersections along Route 460 continue to degrade. Four of the study intersections located west of the Eastern Terminus will operate at LOS D or worse in the 2040 (Design Year). The two signalized intersections located in Windsor will operate at LOS E or F during one or more peak hours. The Route 460 at Route 258/Prince Boulevard intersection will operate at LOS D during the AM peak hour and LOS E in the PM peak hour. The Route 460 at Route 610/603/1810 intersection will operate at LOS F during both the AM and PM peak hours with delays of approximately five minutes in the PM peak hour. Similar to Existing conditions, this is partially due to the inefficiencies of the six-legged intersection configuration. The unsignalized Route 460 at Winston Drive intersection will operate at LOS D in the PM peak due to minimal gaps in traffic along Route 460 for left turning movements from Winston Drive; however, traffic volumes forecasted on this approach are very low (30 vehicles per hour). The Route 460 at Route 634/Kings Fork Rd signalized intersection will operate at LOS D during both the AM and PM peak hours.

5.4.2 Roadway Segments

All roadway segments along Route 460 will operate at LOS C or better under 2040 No Build conditions.

5.4.3 Route 58 at Route 460 and Route 10/Godwin Boulevard Interchanges

Increases in traffic volumes at the Route 58 at Route 460 and Route 10/Godwin Boulevard interchanges will further degrade traffic operations during peak hours in the 2040 Design Year. The westbound Route 58 freeway segment, east of the Route 10/Godwin Boulevard interchange degrades to LOS E during the PM peak hour and westbound Route 58 between Route 460 and Route 10/Godwin Boulevard will operate at LOS D. During the AM peak, eastbound Route 58 east of Route 10/Godwin Boulevard will operate at LOS D. These LOS deficiencies correspond to the directionality of the Route 58 corridor – eastbound toward the Chesapeake area in the AM peak and westbound in the PM peak.

In addition to the freeway segments, the intersections and ramp junctions serving these interchanges will continue to degrade as traffic volumes increase in the 2040 Design Year. At the Route 58 at Route 10/Godwin Boulevard interchange, the westbound Route 58 off-ramp to Route 10/Godwin Boulevard will operate at LOS E in the PM peak. The on-ramp to westbound Route 58 during the PM and the northbound Route 10/Godwin Boulevard on-ramp to eastbound Route 58 during the AM will operate at LOS D. The signalized intersection of Route 10/Godwin Boulevard with the westbound Route 58 ramps will continue to operate at LOS D in both the AM and PM peak hours with the addition of a second westbound right turn lane. The eastbound Route 58 ramps' signalized intersection will operate at LOS D during the AM peak hour.

At the Route 58 and Route 460 interchange, the westbound Route 58 off-ramp to Route 460 will operate at LOS D during the PM peak hour. The existing unsignalized intersection along Route 460 with the westbound Route 58 ramps was converted to a signalized intersection under No Build conditions since it is anticipated that signal warrants would be met in 2040 (Design Year) due to the heavy left turn volume (90 vehicles in the AM peak hour and 80 vehicles in the PM peak hour) from the ramp approach. Otherwise, the unsignalized intersection will operate at LOS F on the ramp approach during both peak hours due to a lack of sufficient gaps in traffic along Route 460. The unsignalized Route 460 at Sadler Pond Drive intersection located just east of the interchange will operate at LOS D during the PM peak hour; however, traffic volumes on the minor street approach are relatively low during peak hours (60 vehicles per hour or less).

The remaining study area intersections, roadway segments, and ramps in the vicinity of the existing interchanges are anticipated to operate at LOS C or better in the 2040 Design Year.

5.5 ANALYSIS OF BUILD CONDITIONS

An analysis of the FHWA/VDOT Preferred Alternative as documented in the Alternatives Technical Report was performed for both the 2021 (Opening Year) and 2040 (Design Year). Capacity analyses were performed using the forecasted traffic volumes and truck percentages for each analysis year. From approximately one mile west of Zuni to two miles west of Windsor the Existing Route 460 would be upgraded to a four-lane divided highway (approximately 4 miles). From approximately two miles west of Windsor to the Route 460 and Route 58 interchange in Suffolk a new four-lane divided highway would be constructed, running north around Windsor, then east of Windsor running south of the Existing Route 460 (approximately 12 miles). New interchanges would be constructed at the intersection of the New Route 460 and Existing Route 460 (located east of Windsor) and at the intersection of Route 460 and Route 58 (Eastern Terminus). The Eastern Terminus interchange provides access from New Route 460 to Route 58 using four flyover ramps. Partial access is provided to Existing Route 460 from relocated General Early Drive and a new Murphy's Mill Connector.

5.5.1 Intersections

In Windsor, the Existing Route 460 at Route 258 signalized intersection will operate at LOS D during the AM peak hour and LOS E during the PM peak hour, similar to No Build conditions, with overall intersection delays under Build conditions within five seconds of No Build conditions. Although eastbound and westbound through volumes on Existing Route 460 decreases significantly with the FHWA/VDOT Preferred Alternative, there is some increase in turning movements (less than a 130 vehicle per hour increase per movement) at the intersection because it is a primary access point to the Route 460 corridor. In the Build scenario, traffic uses Route 258 to reach existing Route 460 to then access the new Route 460 highway. Improvements to widen Route 258 from a two-lane road to a four-lane divided road north and south of the Route 460 intersection including intersection improvements at Route 460 have been identified in the *Isle of Wight County Capital Improvements Plan 2016-2025*. However, these proposed improvements are not included in the Constrained Long Range Plan and are therefore not included in the No Build or Build conditions analysis.

The operation of Existing Route 460 at Route 610/603/1810 signalized intersection in Windsor improves from LOS F to LOS E in both the AM and PM peak hours between No Build and Build conditions due to the reduction in traffic volumes along Existing Route 460 and motorists using the New Route 460 around Windsor. Under Build conditions, overall intersection delays will decrease by 64 percent in the AM peak hour and 74 percent in the PM peak hour.

Immediately west of Antioch Road/Cut Thru Road, a new three-legged signalized intersection (Green-T) will connect the Existing Route 460 with the New Route 460 allowing for the westbound New Route 460 through traffic to flow uninterrupted. Other traffic movements will operate under signal control. The intersection will operate at LOS A during both the AM and PM peak hours in the 2040 Design Year.

Traffic that formerly used Cut Thru Road to access Route 460 would use Route 639/Winston Road, approximately one mile west of Cut Thru Road to access Route 460. This unsignalized intersection will operate at a LOS D for the southbound left turn movement in the PM peak hour due to minimal gaps in traffic along Route 460 for left turning movements from Winston Drive.

The remaining study intersections along Route 460 will operate at LOS C or better under 2040 Design Year conditions including the Route 460 at Route 616/Main Street intersection located in Ivor.

5.5.2 Roadway Segments

All roadway segments along Existing Route 460 as well as the new freeway segments along New Route 460 will operate at LOS B or better under 2040 Build conditions. In general, the operation of Existing

Route 460 segments east of the new Green-T intersection will improve due to the decrease in traffic on Existing Route 460.

5.5.3 New Route 460 at Existing Route 460 Interchange

The New Route 460/Existing Route 460 crossing on the east side of Windsor consists of a diamond interchange with a loop ramp in the northwest quadrant. The two signalized intersections serving the interchange ramps will operate at LOS B in the 2040 Design Year with one exception. The intersection of the westbound New Route 460 ramps and Existing Route 460 will operate at LOS C during the PM peak hour. All merge and diverge junctions along New Route 460 at the Existing Route 460 interchange will operate at LOS B or better under 2040 Build conditions.

5.5.4 Eastern Terminus

The new interchange will provide access from New Route 460 to Route 58 using four flyover ramps, which will remove a substantial portion of traffic from the Existing Route 460 and Route 58 interchange. All of the interchange ramp movements associated with the Eastern Terminus new interchange will operate at LOS C or better in the 2040 Design Year in both the AM and PM peak hours. All of the existing and future intersections associated with the interchange will also operate at LOS C or better with one exception. The unsignalized intersection of Route 460 at Sadler Pond Drive will be converted to a four-legged intersection with the Murphy's Mill Connector forming the south leg of the intersection. The northbound left turn lane on the Murphy's Mill Road approach to Existing Route 460 intersection will operate at LOS F in the 2040 Design Year in the AM and PM peak hours. All other intersection movements will operate at LOS D or better. The installation of a traffic signal would address this LOS deficiency; however, the volumes on the minor street approaches that are causing the LOS deficiency are relatively low (less than 100 vehicles per hour in the AM and PM peak hours) and a traffic signal is not likely to be warranted.

Increases in traffic volumes in the Route 460 corridor when considering both Existing Route 460 and New Route 460 will contribute to increased traffic along the Route 58 corridor. This causes some additional degradation of operations along the Route 58 freeway segments compared to No Build conditions. Specifically, eastbound Route 58 between Route 460 and Route 10/Godwin Boulevard will operate at LOS D during the AM peak hour (compared to LOS C under No Build conditions). No other segments will degrade to LOS D or worse compared to No Build conditions. Westbound Route 58 east of Route 10/Godwin Boulevard will continue to operate at LOS E during the PM peak hour corresponding to the segment and direction of Route 58 with the highest peak hour traffic volumes.

As a result of the increases in traffic volumes along Route 58 in the 2040 Design Year, some degradation in LOS will be experienced at the ramp junctions at the Route 10/Godwin Boulevard interchange. During the AM peak hour, the eastbound and westbound Route 58 off-ramps to Route 10/Godwin Boulevard and the southbound Route 10/Godwin Boulevard on-ramp to eastbound Route 58 will operate at LOS D under Build conditions (compared to LOS C under No Build conditions). All other ramp junctions will remain the same as No Build conditions.

The intersections along Route 10/Godwin Boulevard serving the interchange will operate at the same LOS compared to No Build conditions with two exceptions. The eastbound Route 58 ramps intersection will improve to LOS C in the AM peak hour (compared to LOS D under No Build conditions). The westbound Route 58 ramps intersection also improves to LOS C in the AM peak hour (compared to LOS D under No Build conditions).This is due to reductions in traffic volumes at the intersections including the off-ramps and on-ramps serving Route 58 under Build conditions.

5.6 VEHICLE MILES TRAVELED AND VEHICLE HOURS TRAVELED

Vehicle miles traveled (VMT) and Vehicle Hours Traveled (VHT) are important transportation system performance measures that allow for an evaluation of how a proposed transportation project affects the distance that people travel and the time they spend traveling. VMT is the product of the traffic flow on a roadway link (in vehicles per day) and the link length (in miles). Typically, daily or annual VMT is used as a system performance measure. VHT is the product of the traffic flow (in vehicles per day) and the average time each vehicle spent traveling on a roadway link (in hours). Travel time is calculated based on the average travel speed. Two methods were used to calculate the forecasted VMT and VHT for the No Build and Build conditions. The first used the Tidewater travel demand model results to calculate VMT and VHT for the entire model and the study area. The second used the post-processed volumes and estimated speeds on Route 460 and Old Route 460 to calculate VMT and VHT for those two roadways only.

Tidewater Model Results

The Tidewater model results for VMT and VHT are shown in **Table 5-9**. The inclusion of the FHWA/VDOT Preferred Alternative in the model results in a 0.07 percent predicted increase in the multi-region VMT, but it results in a predicted 0.26 percent decrease in the multi-region VHT. This is consistent with the expectation that some traffic would shift to use the improved Route 460 corridor because it is faster and would save time (reduced VHT) even though the travel distances could increase (increased VMT). The shift in traffic to Route 460 also reduces traffic (and therefore potential congestion) elsewhere in the system. For example, traffic is predicted to decrease on I-64 on the peninsula. The forecasted reduction of 7,810 hours per day from the travel model forecast yields over 2.8 million hours of saved travel time over a one-year time period.

Table 5-9: Tidewater Model Daily VMT and VHT Summary

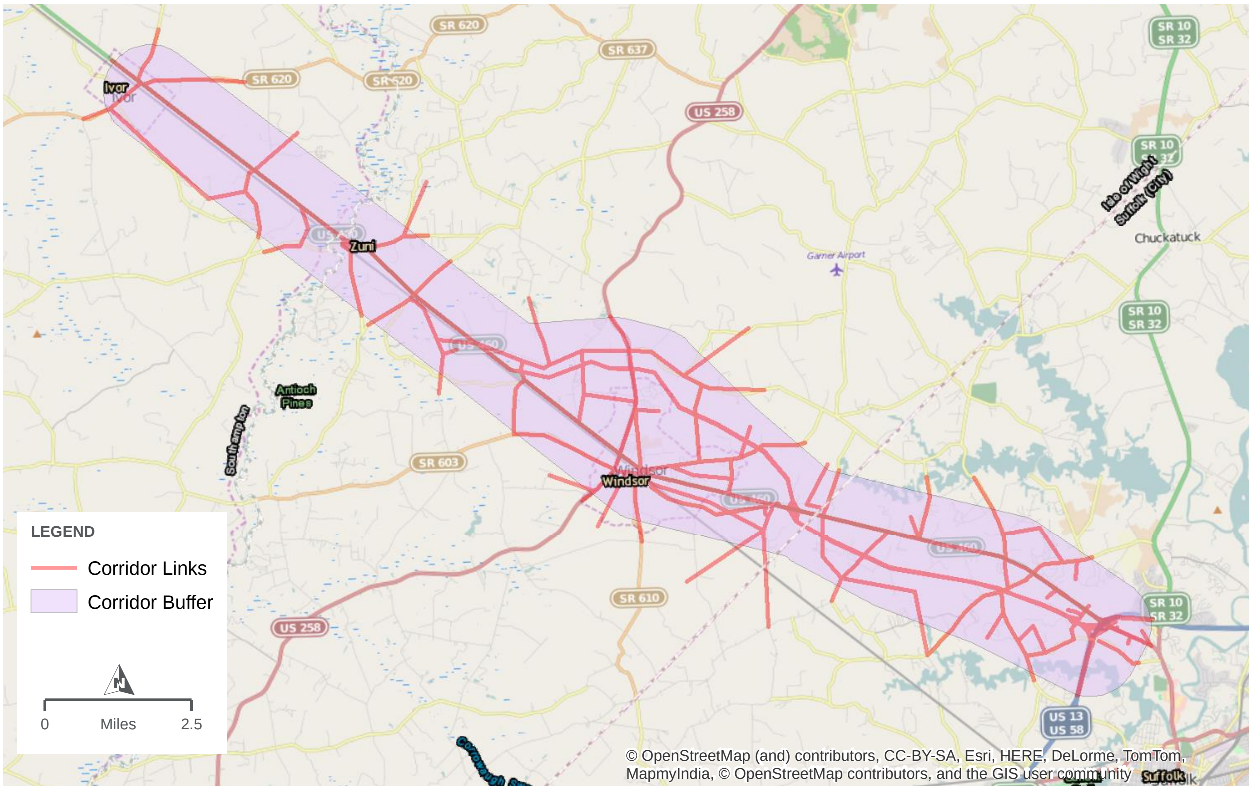
	Daily Vehicle Miles Traveled (1,000s)				Daily Vehicle Hours Traveled			
Year	No Build	Build	Change	%	No Build	Build	Change	%
2013	87,660	-	-	-	2,125,940	-	-	-
2021	96,790	96,820	30	0.03%	2,356,670	2,353,810	-2,860	-0.12%
2040	118,200	118,280	80	0.07%	3,051,820	3,044,010	-7,810	-0.26%

A second model analysis considered the more localized effects of the FHWA/VDOT Preferred Alternative. For this assessment a buffer was placed around the Route 460 corridor to tabulate the VMT and VHT in the immediate vicinity of the highway. The buffer area is shown in **Figure 5-1**. The VMT and VHT results for this area are shown in **Table 5-10**.

Table 5-10: Study Area Daily VMT and VHT Summary

	Daily Vehicle Miles Traveled				Daily Vehicle Hours Traveled			
Year	No Build	Build	Change	%	No Build	Build	Change	%
2013	644,600	-	-	-	14,100	-	-	-
2021	768,900	881,900	113,000	15%	17,200	17,200	0	0%
2040	1,148,900	1,376,100	227,200	20%	28,100	28,600	500	2%

Figure 5-1: Buffer Area for VMT/VHT Calculations



In the No Build scenario, the VMT is projected to nearly double between 2013 and 2040 and the VHT would double. A comparison of the No Build and Build scenarios shows that the 2040 VMT is predicted to increase by 20% with the FHWA/VDOT Preferred Alternative. This reflects the large increase in predicted volumes in the corridor with the proposed project (e.g., more vehicles entering and traveling through the study area with the FHWA/VDOT Preferred Alternative, leading to the increased VMT). Even with the increased traffic, the 2040 VHT in the study area would not change substantially with the FHWA/VDOT Preferred Alternative (2 percent increase). The reason the VHT changes so little is that the overall average speeds in the study area increase by 18 percent. The average travel speeds for the study area, based on the VMT and VHT, are shown in **Table 5-11**. In 2040, the average speed increases from 41 mph in the No Build scenario to 48 mph in the Build scenario. The fact that VHT decreases in the larger model area, but does not decrease in the study area, indicates that there are VHT reductions in other, potentially congested portions of the regional highway network.

Table 5-11: Average Travel Speeds in Study Area (Based on VMT and VHT)

	Average Travel Speeds in the Study Area (mph)			
Year	No Build	Build	Change	%
2013	45.7	-	-	-
2021	44.7	51.3	6.6	15%
2040	40.9	48.1	7.2	18%

Final Corridor Volume VMT/VHT Results

A third approach was used to estimate VMT and VHT for the Route 460 highway, exclusive of other area roadways. For this assessment, the final daily volume forecasts for Route 460 were used to develop the VMT and VHT estimates shown in **Table 5-12**. The analysis does not include the surrounding roadways, but it does include both the New and Existing Route 460 highways. The VMT on Route 460 is projected to increase by nearly 80 percent from 2013 to 2040 in the No Build condition. Implementation of the FHWA/VDOT Preferred Alternative would increase the 2040 VMT by another 40 percent as more traffic uses the corridor and as traffic uses the slightly longer, but faster new Route 460 alignment. The No Build VHT on Route 460 would more than double from 2013 to 2040. The 2040 FHWA/VDOT Preferred Alternative VHT is nearly identical to the No-Build value, even with increased volume, due to the increase in average travel speeds. All of these results show the high forecasted demand for the FHWA/VDOT Preferred Alternative.

Table 5-12: Route 460 Daily VMT and VHT (Existing and New Route 460 Highways)

	Daily Vehicle Miles Traveled				Daily Vehicle Hours Traveled			
Year	No Build	Build	Change	%	No Build	Build	Change	%
2013	205,920	-	-	-	4,683	-	-	-
2021	243,720	321,780	78,060	32%	5,716	5,855	139	2%
2040	363,240	506,250	143,010	39%	9,904	9,936	32	0%

Summary

The FHWA/VDOT Preferred Alternative will reduce travel times by as much as 2.8 million hours per year in the larger region as traffic shifts to use the new high-capacity Route 460 corridor. Within the study area, the FHWA/VDOT Preferred Alternative would attract a substantial amount of new traffic to Route 460, increasing VMT in the study area. The increased average study area speeds will minimize the VHT change in the study area.

5.7 TRAVEL TIME AND OPERATING SPEED

Travel time and operating speed are two key performance measures that would be affected by implementation of the FHWA/VDOT Preferred Alternative. The travel model was used to estimate the future average operating speeds in the corridor. The existing Route 460 model travel times were compared to current estimates and were determined to be reasonable. Projected peak period travel times and the resulting speeds for both Existing Route 460 and the proposed new alignment are presented in **Tables 5-13 and 5-14**. These values correspond to travel from the western limit of the FHWA/VDOT Preferred Alternative to Route 58.

The travel time savings for a peak period vehicle traveling the corridor will be between 4.1 and 5.9 minutes in 2021 and 2040, respectively. This is based on a weighted average of the existing and new Route 460 facilities. For vehicles using the New Route 460, the savings will be between 5.1 and 6.9 minutes. Thus most through traffic (including most trucks) will experience this higher travel time savings.

The average speed for a typical peak period vehicle using the Route 460 corridor is expected to increase by 10.7 to 12.1 mph in 2021 and 2040, respectively. This is a 25 percent to 33 percent increase over the No Build condition. Again, these values take into account vehicles traveling on both the existing and new

Route 460 highways. For vehicles using the New Route 460 the speeds will increase by 14.2 to 15.0 mph in 2021 and 2040, respectively, an increase of 33 to 40 percent.

Table 5-13: Route 460 Projected Travel Times

Peak Period Travel Time in Minutes (Western Project Limit to Route 58)								
Year	No-Build Scenario	Build Scenario			Difference 1 (Build New Route 460 minus No Build)		Difference 2 (Build Weighted Avg minus No Build)	
	Existing Route 460	New Route 460*	Existing Route 460	Weighted Avg.	Travel Time	Percent	Travel Time	Percent
Miles=>	*15.6*	*15.9*	*15.6*	*15.8*	-	-	-	-
2013	21.0	-	-	-	-	-	-	-
2021	21.7	16.6	20.2	17.6	-5.1	-24%	-4.1	-19%
2040	25.2	18.3	21.7	19.3	-6.9	-27%	-5.9	-24%

* To provide comparable end points, this includes the portion on Existing Route 460 from the western project limit to the start of the New Route 460.

Table 5-14: Route 460 Projected Speeds

Peak Period Travel Speeds (mph) (Western Project Limit to Route 58)								
Year	No-Build Scenario	Build Scenario			Difference 1 (Build New Route 460 minus No Build)		Difference 2 (Build Weighted Avg minus No Build)	
	Existing Route 460	New Route 460*	Existing Route 460	Weighted Avg.	Speed	Percent	Speed	Percent
2013	44.5	-	-	-	-	-	-	-
2021	43.2	57.4	46.3	53.9	14.2	33%	10.7	25%
2040	37.2	52.2	43.2	49.3	15.0	40%	12.1	33%

* To provide comparable end points, this includes the portion on Existing Route 460 from the western project limit to the start of the New Route 460.

5.8 SAFETY ANALYSIS

The FHWA/VDOT Preferred Alternative would significantly change the safety characteristics of the Route 460 corridor in the study area. As outlined in the existing conditions section, the current highway is a four-lane undivided facility with few turn lanes, limited shoulders, 11-foot lanes, and areas with numerous intersections and driveways. The FHWA/VDOT Preferred Alternative would address these issues by providing a new grade-separated divided highway for approximately 12 miles and upgrading an additional 4 miles on the existing alignment to include a median and/or turn lanes.

To assess the potential safety benefits of the FHWA/VDOT Preferred Alternative, a Highway Safety Manual (HSM) analysis was conducted. The analysis is a comparative analysis to assess the difference between the two conditions. The HSM predictive methods for rural arterials, urban/suburban arterials, and rural freeways were used to develop 2040 crash frequency predictions. The analysis showed that the No Build condition is predicted to have 179 crashes in 2040, with 65 injury or fatal crashes. The FHWA/VDOT Preferred Alternative is predicted to have 154 crashes in 2040 with 57 injury or fatal crashes. **Table 5-15** presents the summary results of the 2040 HSM analysis.

Table 5-15: 2040 Predicted Crash Frequencies

No-Build 2040 Crash Prediction			
	Total	**Injury/Fatal**	**Property Damage Only (PDO)**
Rural Highway	38	21	16
Urban Highway	127	38	89
Interchange	14	6	8
Total	**179**	**65**	**113**
*No-Build 100MVMT**	*1.3*		
Crashes per 100MVMT	**132.6**	**48.1**	**83.7**
Build 2040 Crash Prediction			
	Total	**Injury/Fatal**	**Property Damage Only (PDO)**
Rural Highway	20	10	10
Urban Highway	49	15	34
Interchange/Freeway	85	32	53
Total	**154**	**57**	**97**
*Build 100MVMT**	*2.0*		
Crashes per 100MVMT	**77.5**	**28.7**	**48.8**

* 100MVMT include freeway ramp travel

The FHWA/VDOT Preferred Alternative is predicted to have fewer crashes in 2040 even though the vehicle miles traveled on Route 460 in that scenario is forecasted to be over 45 percent greater. To normalize the two predictions, both values were converted to crash rates per 100 MVMT. The result is a No Build crash rate of 133 crashes per 100 MVMT (48 fatal/injury crashes per 100 MVMT) and a Build crash rate of 78 crashes per 100 MVMT (29 fatal/injury per 100 MVMT). This is a crash rate reduction of over 40 percent for both total and fatal/injury crashes.

To accurately express the safety differences between the two scenarios it is necessary to consider the crash reduction for a constant volume of traffic. Therefore a crash reduction calculation was conducted using the No Build volumes. Using the No Build volume and applying the 2040 crash rates results in a crash savings of over 1,000 crashes over the 20 year design horizon, including 400 injury or fatal crashes.

6.0 HURRICANE EVACUATION

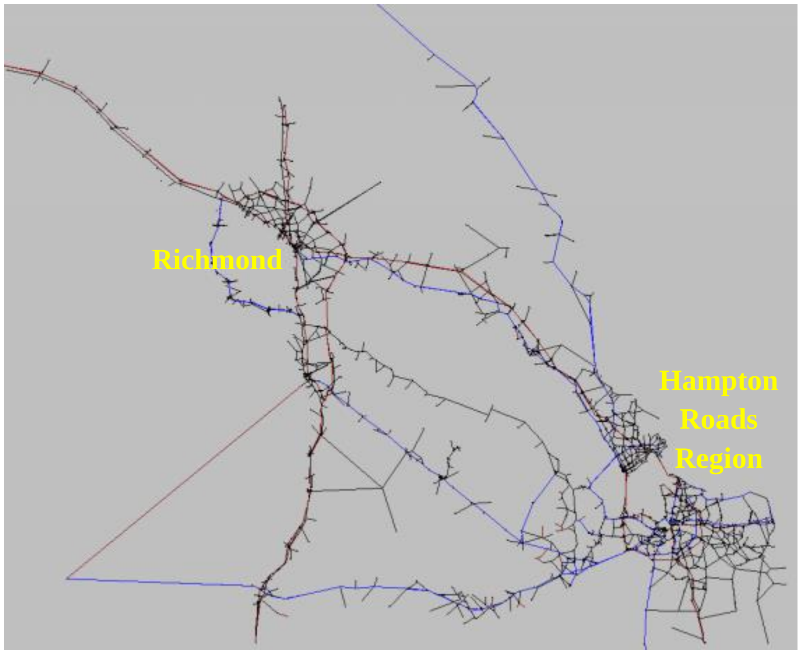
6.1 HURRICANE EVACUATION

The ability to evacuate the Hampton Roads region in advance of a hurricane is a major regional need. Large transportation projects in the region are often evaluated to determine the benefit they offer for improving evacuation times either in a corridor or regionally. Given the size of the region, it is difficult to make dramatic changes in the overall evacuation time, but large projects can provide quantifiable benefits as well as added system flexibility.

6.2 HURRICANE EVACUATION MODEL

In 2014, the Virginia Transportation Research Council (VTRC), formerly the Virginia Center for Transportation Innovation and Research (VCTIR), developed the Hampton Roads hurricane evacuation model to be able to evaluate the benefits of major transportation improvements in the Hampton Roads region. The model was developed using the DynusT mesoscopic simulation modeling platform and addresses an over 25 hour hurricane evacuation timeframe. The extent of the model is shown in **Figure 6-1**.

Figure 6-1: Hampton Roads Hurricane Model Network



6.3 MODEL SCENARIOS AND MODEL METHODS

To evaluate the benefits of the Route 460 project two model scenarios were employed. The first was a baseline scenario that used the current regional transportation system plus reverse flow operations on Route 58 east of Route 460. The second scenario added the FHWA/VDOT Preferred Alternative for Route 460, including the 11.5 miles of new grade separated four-lane divided highway. The new grade-separated section of Route 460 was also assumed to be able to be operated with reverse flow in the eastbound lanes.

The Hampton Roads hurricane evacuation model in DynusT is a complex mesoscopic simulation model, not a macroscopic travel demand model. Therefore, the model results vary depending on the initial input seed number. To address the issue of model output variability, multiple runs were conducted for each scenario and the results were averaged. The VDOT sample size determination tool was consulted to set the number of runs. Based on a review of the Route 460 clearance time data, thirteen runs were conducted for each scenario. This exceeded the number of runs needed to yield a 95 percent confidence level and a 5 percent tolerance error for calculating the average clearance times for the two scenarios. The model developers used an iterative model running process with a user equilibrium path choice. To be consistent with the original model that same approach was used.

6.4 MODEL RESULTS

The model results were summarized for both overall system performance measures and corridor clearance times. The system performance measures are presented in **Table 6-1**. As shown, the model showed system-wide travel time benefits due to the addition of the Route 460 project. This included 5.3 minute (3.2 percent) lower system-wide average travel times per vehicle and 3.2 minute (4.7 percent) lower system-wide average stopped times per vehicle. The total travel time reduction for all vehicles in the model was approximately 66,000 vehicle hours, which is 122,100 person hours based on a an average occupancy of 1.85 persons per vehicle.

Table 6-1: Hurricane Evacuation System-Wide Performance Measures

	Baseline Scenario	Preferred Alternative	Change	%
Avg. Travel Time per Vehicle (min)	168.0	162.7	-5.3	-3.2%
Avg. Stop Time per Vehicle (min)	68.1	64.9	-3.2	-4.7%
Total Travel Time Savings (vehicle hrs)	-	66,000	-	-
Total Travel Time Savings (person hrs) [1]	-	122,100	-	-

[1] Average vehicle occupancy for all vehicles in the model is estimated at 1.85 persons/vehicle based on the 2008 Virginia Hurricane Evacuation Study (2.02 persons/vehicle for evacuees) and the Hampton Roads Regional Travel Model (1.33 persons/vehicle for non-evacuee local traffic).

Another system benefit is that the capacity of a key evacuation route on the western edge of the region would be increased. Several high capacity evacuation corridors are located to the north on the peninsula, including I-64 (both directions), Route 60, and Route 17. These routes are predicted to serve over 60 percent of the traffic evacuating the region. Improvements to Route 460 would redistribute more traffic to the west and away from the congested peninsula routes. Therefore the improvement would rebalance the traffic flows, allowing some evacuees to use a more direct route to safety. The effects of this redistribution are captured in the corridor level model results.

The corridor results indicated how much evacuation traffic used each corridor and how long it took traffic on a particular corridor to clear past a specific point. **Table 6-2** presents the volume of traffic that was predicted to use the six highest volume evacuation corridors, based on an average of all model runs.

Table 6-2: Average Evacuating Vehicles by Corridor

Evacuation Route	Baseline Scenario Volume (vehicles)	Preferred Alternative Volume (vehicles)	Change in Volume (vehicles)	%
I-64 (primary direction)	60,600	59,500	-1,100	-1.8%
I-64 (reverse direction)	42,700	42,100	-600	-1.4%
Route 60	35,700	30,000	-5,700	-16.0%
Route 10	20,400	21,000	600	2.9%
Route 460	46,800	54,100	7,300	15.6%
Route 58	33,900	33,000	-900	-2.7%

As noted above, traffic redistributed with a substantial decrease on Route 60 (-16 percent) and a substantial increase on Route 460 (+15.6 percent). This shift is due to the increased capacity and speeds on a critical section of Route 460, combined with projected congestion on Route 60. Essentially the model reaches a new equilibrium with more traffic headed west on Route 460 and an overall reduction in travel times. The 7,300 vehicle (14,750 people) increase on Route 460 also translates into an increased average hourly flow on that corridor from 1,930 vehicles per hour to 2,220 vehicles per hour or an average or 300 more cars (600 more people) evacuated per hour on average, which is a 14.7 percent increase.

The model addresses an over 24-hour time period; however, the distribution used to load evacuating vehicles onto the roadway network lasts 16 hours (with the peak occurring in hour 12). Therefore, the clearance time presented below was the length of time from when the last evacuee enters the road system until each corridor was clear of evacuating traffic. This was the time frame that could be influenced by an improved roadway system. **Table 6-3** presents the model corridor clearance results using this definition for clearance times.

Overall, the predicted traffic shifts result in a 3.2 percent reduction in the weighted average corridor clearance time for the entire system (16 minutes). This is consistent with the system-wide benefits described previously. At the corridor level, however, I-64 had clearance time reductions of one hour for the reverse flow lanes and 0.6 hours (36 minutes) for the primary direction lanes. Thus, the decreases on these facilities, combined with the decrease on Route 60 are predicted to improve traffic flow on I-64. Even with the additional 7,300 vehicles on Route 460, the clearance time remains similar, with an increase of 12 minutes (2.4%).

Table 6-3: Average Corridor Clearance Times

Evacuation Route	Baseline Scenario (hours)*	FHWA/VDOT Preferred Alternative (hours)*	Change (hours)	%
I-64 (primary direction)	9.7	9.1	-0.6	-6.2%
I-64 (reverse direction)	6.5	5.5	-1.0	-15.4%
Route 60	10.5	10.5	0.0	0.0%
Route 10	8.4	8.7	0.3	3.6%
Route 460	8.2	8.4	0.2	2.4%
Route 58	8.3	8.5	0.2	2.4%
Weighted Average	8.65	8.37	-0.28	-3.2%

**The time between when the last evacuee leaves home until each corridor is clear of the evacuating traffic.*

In addition to the increased capacity in the Route 460 corridor and the reduced corridor clearance times, the FHWA/VDOT Preferred Alternative also provides additional system redundancy and the ability to accommodate incidents during evacuations in the stretch of highway from Route 58 to west of Windsor. Instead of traffic having to use the existing Route 460/Route 58 interchange and pass through downtown Windsor, there are now three routes that can be used to travel from Route 58 to west of Windsor (both sets of lanes on the New Route 460 alignment and the Existing Route 460 highway). System redundancy can be very beneficial in emergency situations where vehicle breakdowns or other incidents may occur. Furthermore, the existing Blackwater River Bridge located just west of Zuni is currently eight feet below the FEMA 100-year flood elevation and is not traversable during major flooding events. New Route 460 would be raised over 15 feet to provide adequate hydraulic capacity and serve as an emergency evacuation route.

Overall, the new corridor removes the constraint points at the existing Route 460 / Route 58 interchange and on Route 460 in downtown Windsor, which limit evacuation on the existing facility. With the removal of these constraint points the evacuation traffic can flow more smoothly all the way to Zuni. By removing the most limiting locations, overall evacuation movements during the peak times can increase. Prior to reaching Zuni, some traffic will use Route 258 and Route 10 to travel to the west. Thus there will be some dispersion along the route, reducing the amount of traffic that will travel to Zuni and Ivor and points west on Route 460.

Furthermore, the increase in speeds from Route 58 to Zuni will increase the amount of traffic using this corridor during the evacuation period, which will lower the system-wide average travel time. It will also delay the point at which I-64 or other facilities reach capacity during an evacuation scenario. The improved Route 460 corridor will be a relatively high speed alternative to some of the other routes, decreasing travel times for the overall system-wide clearance times from Hampton Roads.

In addition to the tabular results, several No Build and Build scenario screen captures are provided in **Figure 6-2** to show model simulated vehicle positions at different times during the evacuation clearance simulations completed for the analysis.

6.5 HURRICANE MODEL SUMMARY

The Hampton Roads hurricane evacuation model results show that with the FHWA/VDOT Preferred Alternative the Route 460 corridor could serve 7,300 additional vehicles (14,750 people, an increase of 15.6 percent) over an approximately 25-hour hurricane evacuation event when compared to the baseline condition. This traffic will shift to Route 460 from the congested northern corridors (Route 60 and I-64), which will reduce clearance times on some of those routes, including a one-hour reduction on the reverse flow lanes on I-64. The FHWA/VDOT Preferred Alternative would also provide overall system-wide transportation benefits, including a reduction of 66,000 vehicle hours of travel time (122,000 person hours) to all transportation system users during the 25-hour evacuation period.

7.0 FREIGHT MOBILITY

7.1 TRUCK TRAFFIC

Route 460 is a major truck route between the Hampton Roads and the Richmond/Tri-Cities regions. HRTPO has identified Route 460 as the third highest truck traffic gateway in the Hampton Roads region at approximately 2,199 trucks each weekday in 2010, behind only I-64 (5,165 trucks per day) and Route 58 (3,047 trucks per day). [2]

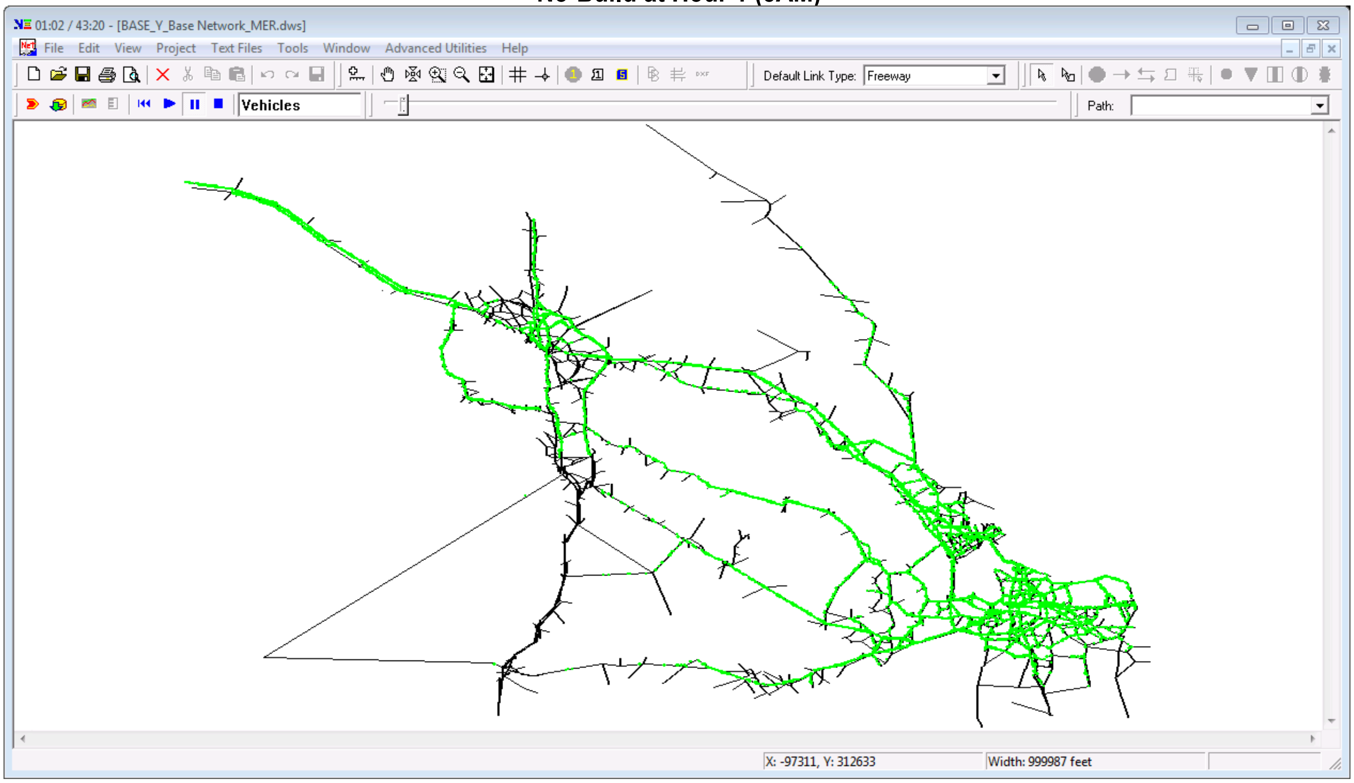
Based on surveys performed as part of the *Route 460 Investment Grade Traffic and Revenue Study* (November 2012), 25 percent of all truck traffic is directly related to the ports, with the majority of truck traffic having long distance origins or destinations outside of the Hampton Roads area. Freight activity between the Richmond and Hampton Roads regions is also anticipated to increase as the Virginia Port Authority (VPA) plans to expand existing port facilities and operations as large distribution centers (+800,000 square feet) locate themselves in either of the two markets or along the key corridors serving those areas.

Distribution centers already located within and near the study area are operated by Food Lion in Prince George County, Wal-Mart in Dinwiddie County, Sysco Food, Ace Hardware, Naval Exchange (NEX), California Cartage Company, QVC, and Target in Suffolk, and Dollar Tree in Chesapeake. These facilities all currently use Route 460 as an important link to serve their customers and retail outlets.

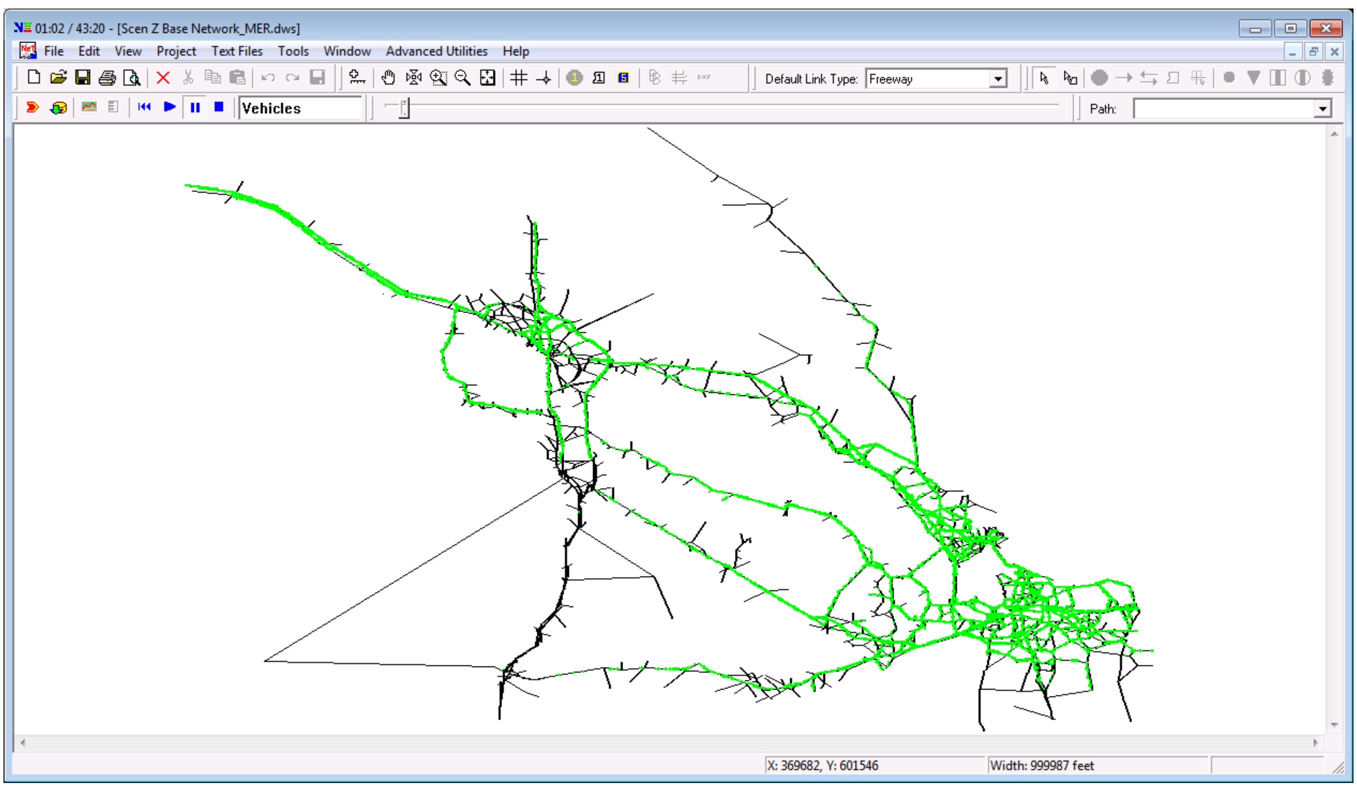
[2] *Positioning Hampton Roads for Freight Infrastructure Funding – MAP 21 and Beyond*, HRTPO, March 2014.

Figure 7-1: Screen Captures of Model

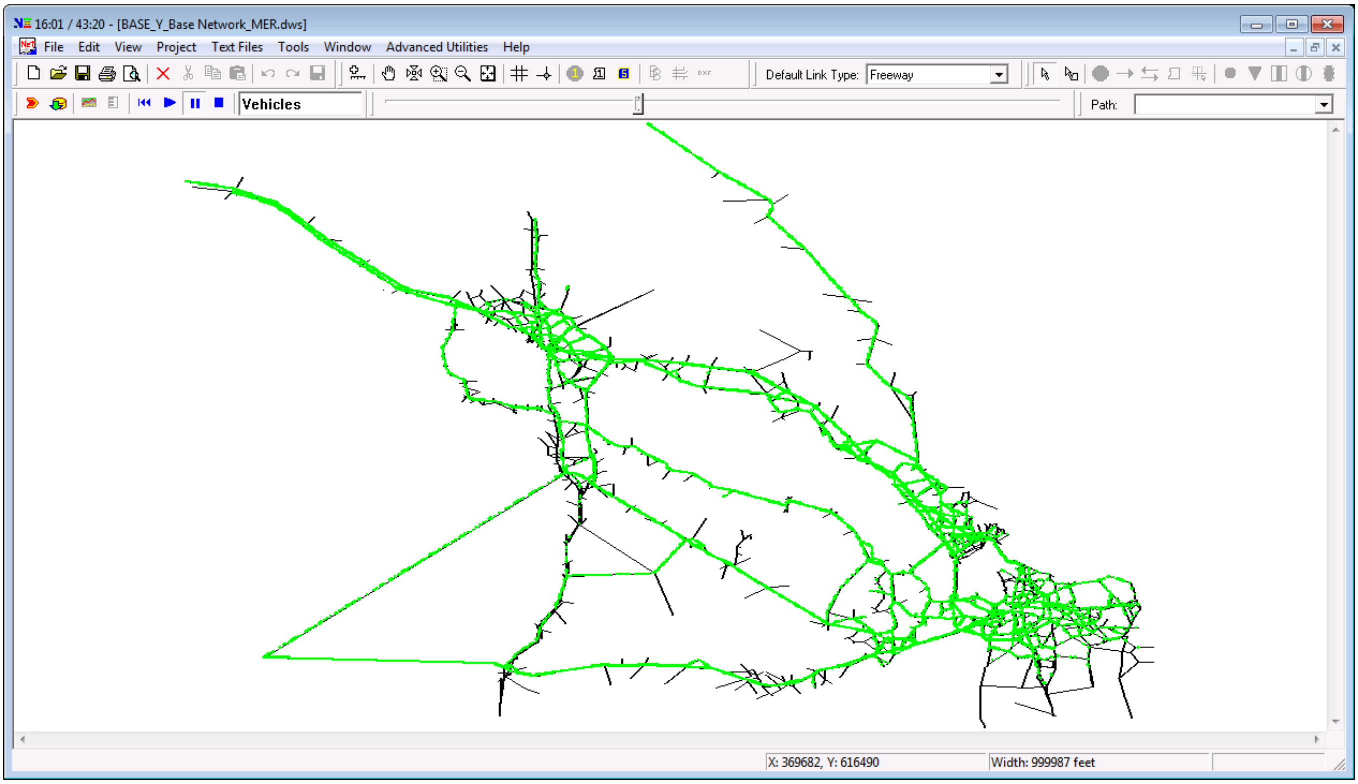
No-Build at Hour 1 (8AM)



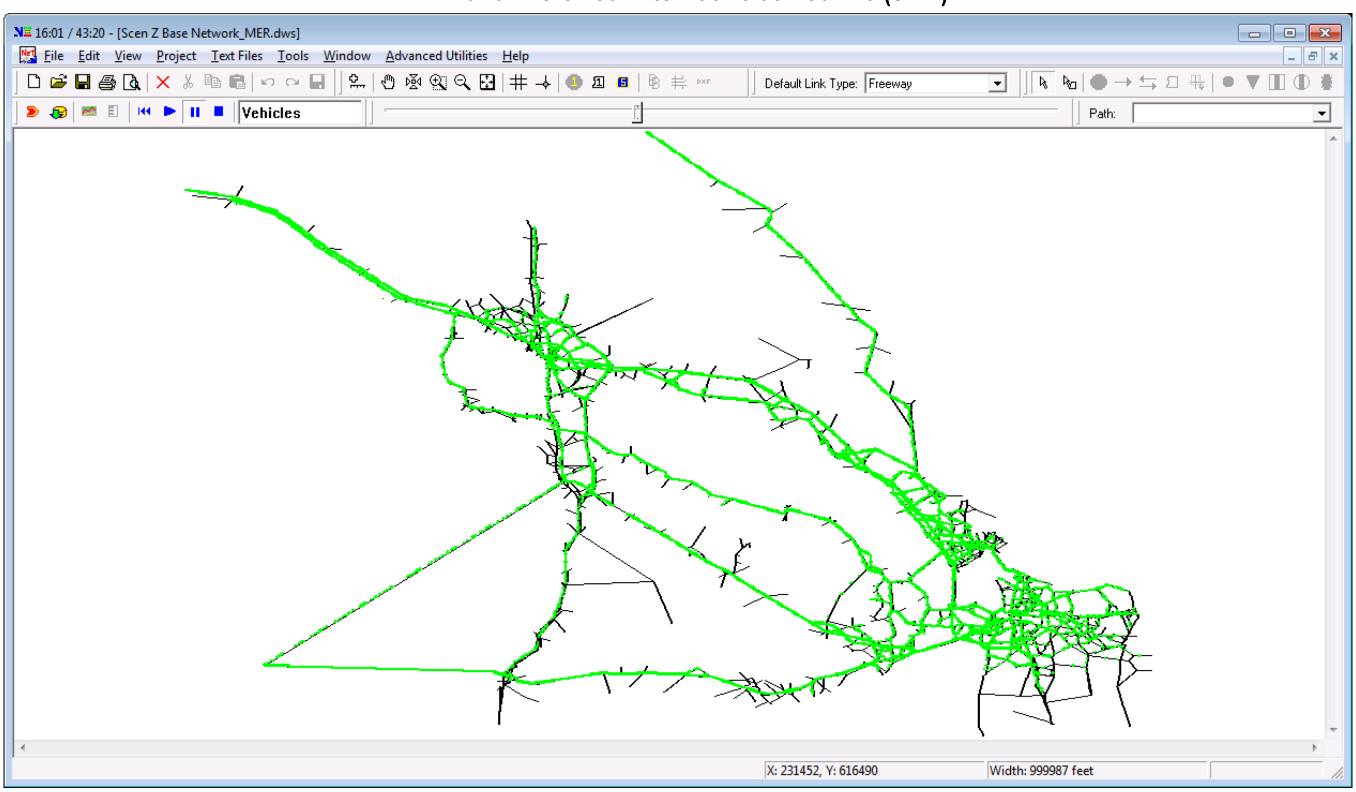
Build Preferred Alternative at Hour 1 (8AM)



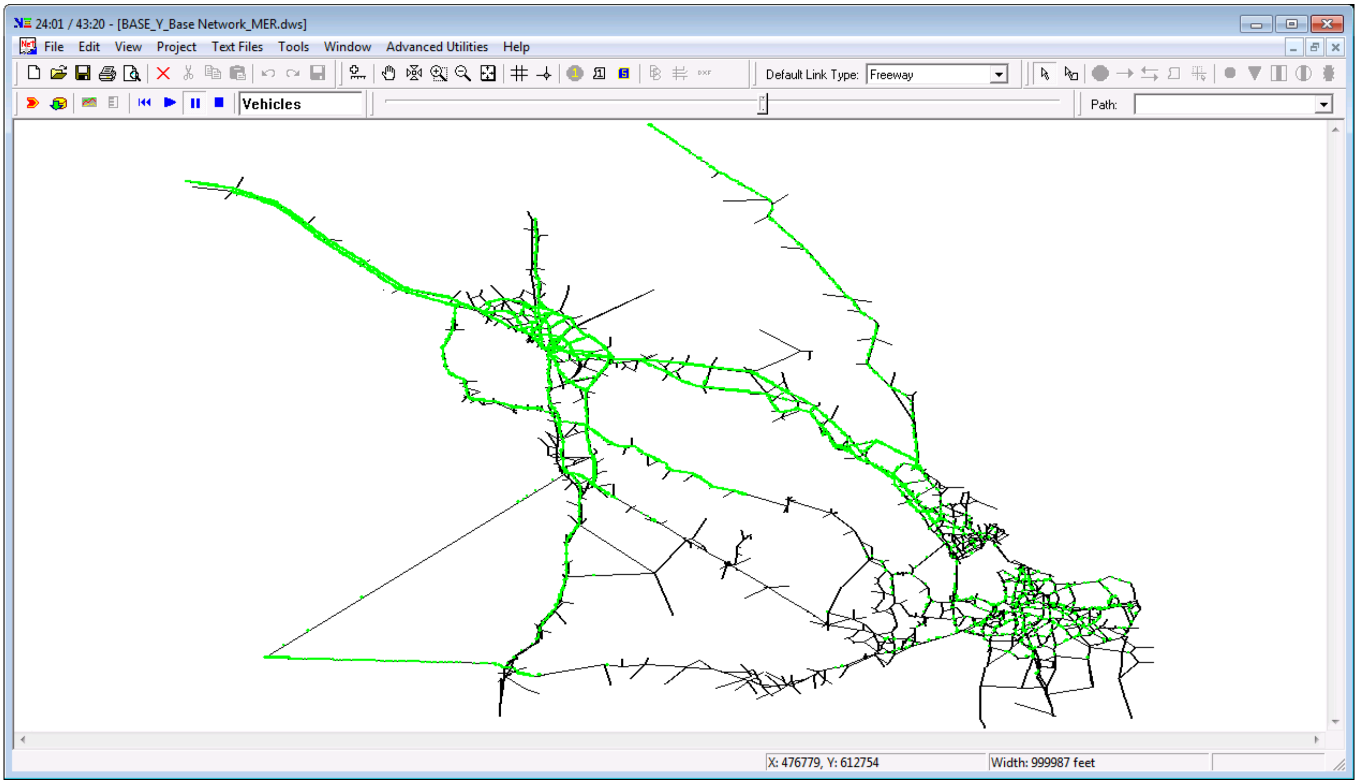
No-Build at Hour 16 (8PM)



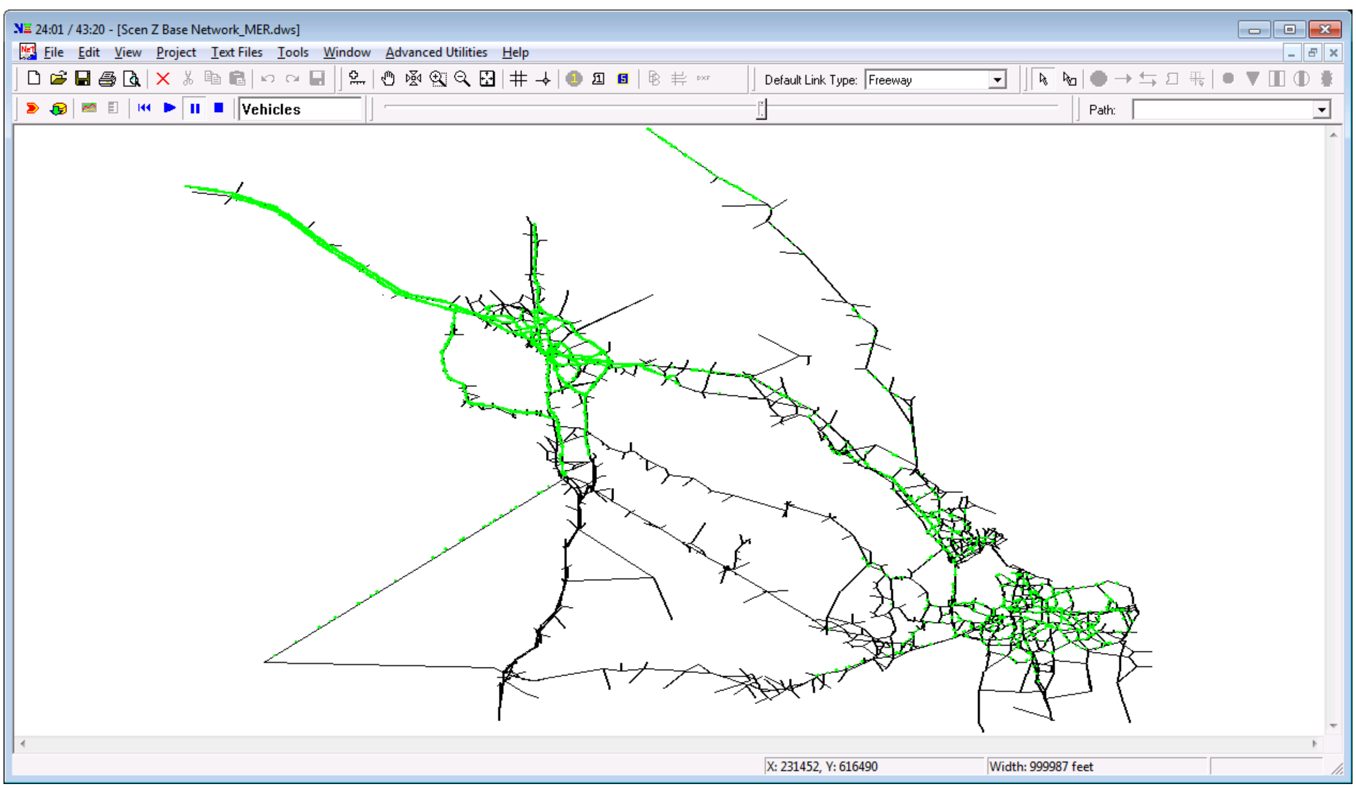
Build Preferred Alternative at Hour 16 (8PM)



No-Build at Hour 24 (7AM)



Build Preferred Alternative at Hour 24 (7AM)



Daily truck traffic for 2013 on Route 460 in the study area was over 2,100 trucks per day in Zuni, which was 23 percent of the total daily volume. In Windsor the volume reached 2,400 trucks per day, which was 16 percent of the total traffic. Near Route 58 the total exceeded 2,500 trucks per day (12 percent of the total traffic volume). Route 460 in Zuni is one of just a few highways in the entire Hampton Roads region to have both a high truck percent (23 percent) and a total truck volume that exceeds 2,000 trucks per day. This uniquely high truck percentage is an important factor in the decision making for roadway upgrades and design in the Route 460 corridor.

7.2 COMPARISON OF ALTERNATIVES

Truck traffic is sensitive to travel time, delays, and system reliability. Other key factors are safety, truck restrictions, and ease of travel. In the No Build condition traffic delays would increase in the corridor, particularly at key signalized intersections. The overall travel speeds would also decrease as was outlined previously. The net result would be increased trucking costs in the Route 460 corridor.

With the FHWA/VDOT Preferred Alternative, the signalized intersections would all be avoided and the average travel time savings for using the new route from Zuni to Route 58 would be approximately six minutes. The new Route 460 facility would also be more reliable in that incidents would be less likely to cause a blockage on the new Route 460 than on the old Route 460.

The safety (and likelihood of an incident) would also be improved on the New Route 460. The road would also be more convenient for truck travel as there would be no stops and the ramp and mainline design would accommodate trucks more efficiently.

The FHWA/VDOT Preferred Alternative is predicted to attract up to 90 percent of the truck traffic on Route 460 in 2040. The volume using the new highway would be approximately 4,400 trucks per day compared to approximately 500 trucks per day west of Route 258 on Existing Route 460. The volume on the east side of Windsor would grow to over 1,000 trucks per day due to predicted industrial growth in the area.

8.0 REFERENCES

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LIST OF ACRONYMS

Acronym	Definition
ADT	Average Daily Traffic
AWDT	Average Weekday Traffic
CBA	candidate build alternatives
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CTB	Commonwealth Transportation Board
DEIS	Draft Environmental Impact Statement
DOD	Department of Defense
ENTRADA	Environmental Traffic Data
FEIS	Final EIS
FFS	Free Flow Speed
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HSM	Highway Safety Manual
ITS	Intelligent Transportation System
LEDPA	Least Environmentally Damaging Practicable Alternative
LOS	Level of Service
MVMT	Million vehicles miles traveled
NCHRP	National Cooperative Highway Research Program
NEX	Naval Exchange
NEPA	National Environmental Policy Act
Pc/mi/ln	Passenger car per mile per lane
PHF	Peak Hour Factor
ROD	Record of Decision
SEIS	Supplemental Environmental Impact Statement
SPF	Safety Performance Function
STRAHNET	Strategic Highway Network
SYIP	Six-Year Improvement Program
TAZ	Traffic Analysis Zone
TOATG	Traffic Operations Analysis Tool Guidebook
TSM	Transportation System Management
TWLTL	Two-way left turn lane
TWSC	Two-way STOP Controlled
USACE	United States Army Corps of Engineers
V/C	Volume-to-Capacity
VCTIR	Virginia Center for Transportation Innovation and Research
VDOT	Virginia Department of Transportation
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
VPA	Virginia Port Authority
VTRC	Virginia Transportation Research Council

APPENDIX A: CRASH DATA

CRASH SUMMARY BY KIND OF HIGHWAY 2012

NUMBEROFLANE	FACILITY	FACILITYDESCRIPTION	DVMT	LEN	PKLD	PINJRD	TCRSH	DEATH RATE *	INJ RATE*	CRASH RATE*
1	3	Divided, full control of access	70,922	6	1	12	28	3.86	46.36	108.16
	4	One-way, part of a one-way system	585,306	184	6	718	1,778	2.81	336.08	832.25
	6	One-way couplet	3,517	0	0	0	3	0.00	0.00	233.69
2	0	Two-way, non-divided	52,602,619	31,750	383	21,377	38,716	1.99	111.34	201.65
	1	Divided, no control of access	283,743	41	1	192	312	0.97	185.39	301.26
	2	Divided, partial control of access	54,424	5	0	33	52	0.00	166.12	261.77
	3	Divided, full control of access	32,050,429	1,644	62	2,830	6,208	0.53	24.19	53.07
	4	One-way, part of a one-way system	937,978	115	2	688	1,413	0.58	200.96	412.72
	5	Two-way, part of a one-way system	87,373	9	0	72	134	0.00	225.77	420.18
	7	Transition	195,509	27	0	101	154	0.00	141.53	215.80
	B	Two-way structure (bridge, tunnel, causeway, etc.	114,780	4	0	18	32	0.00	42.96	76.38
3	0	Two-way, non-divided	1,256,139	194	5	695	1,252	1.09	151.58	273.07
	1	Divided, no control of access	210,863	19	1	103	173	1.30	133.83	224.78
	2	Divided, partial control of access	31,032	2	0	16	18	0.00	141.26	158.92
	3	Divided, full control of access	21,846,151	496	21	2,725	5,746	0.26	34.17	72.06
	4	One-way, part of a one-way system	276,450	28	1	222	444	0.99	220.01	440.02
	5	Two-way, part of a one-way system	2,859	1	0	9	6	0.00	862.55	575.03
	7	Transition	35,220	5	0	6	15	0.00	46.67	116.68
4	0	Two-way, non-divided	9,686,076	700	35	5,516	8,928	0.99	156.02	252.53
	1	Divided, no control of access	37,328,248	2,426	142	12,497	21,091	1.04	91.72	154.80
	2	Divided, partial control of access	4,676,458	239	12	1,256	2,177	0.70	73.58	127.54
	3	Divided, full control of access	19,227,208	534	21	2,176	4,312	0.30	31.01	61.44
	4	One-way, part of a one-way system	37,482	4	0	58	98	0.00	423.94	716.32
	5	Two-way, part of a one-way system	24,797	3	0	20	36	0.00	220.97	397.75
	7	Transition	36,706	3	0	18	46	0.00	134.35	343.35
5	0	Two-way, non-divided	65,222	4	0	47	93	0.00	197.43	390.66
	1	Divided, no control of access	929,854	32	5	596	1,017	1.47	175.61	299.65
	2	Divided, partial control of access	237,194	8	0	84	169	0.00	97.02	195.20
	3	Divided, full control of access	1,865,141	28	0	201	423	0.00	29.53	62.13
	4	One-way, part of a one-way system	6,975	1	0	5	11	0.00	196.41	432.09
6	0	Two-way, non-divided	108,347	4	1	83	111	2.53	209.88	280.68
	1	Divided, no control of access	6,512,643	171	15	3,586	6,103	0.63	150.86	256.74
	2	Divided, partial control of access	2,268,621	34	2	392	671	0.24	47.34	81.03
	3	Divided, full control of access	1,510,098	25	2	190	328	0.36	34.47	59.51

* Rate Per 100 Million Vehicle Miles of travel ,PKLD-Person Killed, PINJRD-Person Injured, TCRASH-Total Crash, DVMT where at least one crash occured

CRASH SUMMARY BY KIND OF HIGHWAY 2012

NUMBEROFLANE	FACILITY	FACILITYDESCRIPTION	DVMT	LEN	PKLD	PINJRD	TCRSH	DEATH RATE *	INJ RATE*	CRASH RATE*
6	4	One-way, part of a one-way system	13,454	1	0	52	44	0.00	1,058.90	895.99
	5	Two-way, part of a one-way system	6,404	0	0	0	1	0.00	0.00	42.78
7	0	Two-way, non-divided	4	0	0	0	1	0.00	0.00	69,890.97
	1	Divided, no control of access	297,732	6	0	136	259	0.00	125.15	238.33
	2	Divided, partial control of access	72,108	1	1	20	44	3.80	75.99	167.18
	3	Divided, full control of access	134,157	2	0	14	21	0.00	28.59	42.89
8	1	Divided, no control of access	1,143,487	24	4	434	783	0.96	103.98	187.60
	2	Divided, partial control of access	5,568	1	0	21	27	0.00	1,033.33	1,328.57
	3	Divided, full control of access	67,325	1	0	3	9	0.00	12.21	36.62
9	1	Divided, no control of access	29,800	1	0	13	22	0.00	119.52	202.26
10	3	Divided, full control of access	85,432	1	0	4	9	0.00	12.83	28.86

* Rate Per 100 Million Vehicle Miles of travel ,PKLD-Person Killed, PINJRD-Person Injured, TCRASH-Total Crash, DVMT where at least one crash occured

2012 Summary of CRASH Data

INTERSTATE,PRIMARY AND SECONDARY SYSTEM UNDER JURISDICTION OF VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT Virginia Department of Transportation
Traffic Engineering

Virginia Department Of Transportaion
Traffic Engineering Division

Disclaimer:

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Virginia Department Of Transportaion
Traffic Engineering Division

CRASH SUMMARY BY YEARS /ALL VIRGINIA HIGHWAYS,STREETS AND ROADS

YEAR	DVMT	FAT CRASH	PER KIL	PED KILL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	INJ RATE *	DEATH RATE *
2004	187,832,063	837	922	87	55,194	78,487	1,893	97,876	153,907	17,370	224.49	114.48	1.34
2005	187,521,231	875	946	91	53,727	76,023	1,773	99,247	153,849	16,906	224.78	111.07	1.38
2006	190,362,079	865	961	83	52,083	73,348	1,923	98,743	151,691	15,937	218.32	105.56	1.38
2007	192,623,629	940	1,026	88	49,139	68,824	1,761	95,325	145,404	14,916	206.81	97.89	1.46
2008	204,505,906	763	824	76	48,892	69,140	1,690	85,632	135,287	12,991	181.24	92.61	1.10
2009	202,561,918	694	756	73	44,250	60,410	1,397	76,125	121,069	9,953	163.75	81.59	1.03
2010	204,260,230	689	740	76	42,732	56,933	1,518	72,480	115,901	9,255	155.46	81.72	0.99
2011	202,037,415	703	767	76	43,979	63,360	1,712	75,792	120,474	8,595	163.37	85.92	1.04
2012	201,125,538	714	775	100	44,880	66,941	1,848	77,831	123,425	8,187	168.13	91.19	1.06

* Rate Per 100 Million Vehicle Miles of travel / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

INTERSTATE

(Crash Statistics Include Interstate System on Main line only)

CRASH SUMMARY BY YEARS / INTERSTATE ROADS

YEAR	DVMT	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	INJ RATE *	DEATH RATE *	A INJ RATE *
2004	64,883,165	101	119	7	6,103	8,865	25	12,376	18,580	3,336	78.46	37.43	0.50	14.09
2005	64,933,639	113	124	6	5,851	8,499	22	12,240	18,204	3,154	76.81	35.86	0.52	13.31
2006	65,529,832	114	138	5	5,578	8,132	26	11,664	17,356	3,100	72.56	34.00	0.58	12.96
2007	66,295,692	100	117	7	5,180	7,454	22	11,438	16,718	2,822	69.09	30.80	0.48	11.66
2008	64,471,137	77	91	6	5,129	7,397	24	9,969	15,175	2,092	64.49	31.43	0.39	8.89
2009	65,628,912	91	102	9	4,804	6,784	27	10,463	15,358	1,780	64.11	28.32	0.43	7.43
2010	66,261,378	92	103	9	4,932	6,739	33	10,816	15,840	1,884	65.49	27.86	0.43	7.79
2011	65,494,232	95	114	8	4,987	7,479	31	10,781	15,863	1,759	66.36	31.29	0.48	7.36
2012	65,494,232	83	91	7	4,906	7,446	35	10,736	15,725	1,469	65.78	31.15	0.38	6.15

* Rate Per 100 Million Vehicle Miles of travel / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY DISTRICT / INTERSTATE ROADS / YEAR 2012

DISTRICT	DISTRICTNAME	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	INJ RATE *	DEATH RATE *	A INJ RATE *
1	Bristol	9	10	0	198	331	2	482	689	84	47.69	22.91	0.69	5.81
2	Salem	9	10	0	272	401	1	658	939	89	51.61	22.04	0.55	4.89
3	Lynchburg	0	0	0	0	0	0	8	8	0				
4	Richmond	13	15	2	872	1,412	9	1,966	2,851	291	56.50	27.98	0.30	5.77
5	Hampton Roads	12	12	1	1,268	1,919	10	2,620	3,900	439	82.70	40.69	0.25	9.31
6	Fredericksburg	7	7	1	301	470	2	714	1,022	126	53.72	24.70	0.37	6.62
7	Culpeper	4	4	0	123	167	0	338	465	35	51.38	18.45	0.44	3.87
8	Staunton	17	18	1	375	561	6	830	1,222	138	42.08	19.32	0.62	4.75
9	Northern Virginia	12	15	2	1,497	2,185	5	3,120	4,629	267	89.57	42.28	0.29	5.17

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY TYPE OF COLLISION / INTERSTATE ROADS / YEAR 2012

TYPE OF COLLISION	COLLISIONTYPE	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Angle	02	6	7	0	431	698	3	807	1,244	164
Backed Into	15	0	0	0	1	2	0	13	14	0
Deer	10	0	0	0	45	52	0	687	732	7
Fixed object in road (from ditch to ditch)	06	1	1	0	39	47	0	67	107	13
Fixed object off road (from outside of ditch)	09	39	41	0	1,331	1,784	2	2,492	3,862	520
Head on	03	2	2	0	30	60	0	43	75	22
Miscellaneous or other	16	1	1	0	56	77	0	112	169	21
Motorcyclist	14	0	0	0	3	3	0	0	3	3
Non-Collision	08	5	7	0	171	242	0	125	301	96
Other Animal	11	0	0	0	5	7	0	31	36	1
Pedestrian	12	5	5	5	13	15	13	2	20	10
Rear End	01	20	23	2	2,367	3,820	14	4,943	7,330	516
Sideswipe - Opposite direction of travel	05	0	0	0	15	28	0	8	23	3
Sideswipe - Same direction of travel	04	4	4	0	399	611	3	1,406	1,809	93
Grand Total		83	91	7	4,906	7,446	35	10,736	15,725	1,469

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY LIGHTING CONDITIONS / INTERSTATE ROADS / YEAR 2012

LIGHTINGS	LIGHTING CODE	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Not Stated	Null	1	1	0	0	0	0	3	4	0
Darkness - Street or Highway Lighted	4	10	13	1	650	1,001	7	1,357	2,017	193
Darkness - Street or Highway not Lighted	5	29	32	3	786	1,203	13	1,808	2,623	328
Dawn	1	0	0	0	109	151	1	302	411	39
Daylight	2	41	43	3	3,258	4,924	14	7,060	10,359	882
Dusk	3	2	2	0	103	167	0	205	310	27
Not Stated	6	0	0	0	0	0	0	1	1	0
Grand Total		83	91	7	4,906	7,446	35	10,736	15,725	1,469

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY SURFACE CONDITIONS / INTERSTATE ROADS / YEAR 2012

SURFACE CONDITION	SURFACECOND CODE	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Not Stated	Null	0	0	0	7	10	0	18	25	5
Dry	1	66	74	7	3,989	6,090	31	8,532	12,587	1,227
Icy	4	0	0	0	57	83	0	160	217	14
Muddy	5	0	0	0	0	0	0	1	1	0
Natural Debris	8	0	0	0	1	1	0	1	2	0
Oil/Other Fluids	6	0	0	0	3	3	0	8	11	0
Other	7	1	1	0	1	1	0	3	5	0
Roadway Flooded	9	0	0	0	11	14	0	34	45	2
Snowy	3	0	0	0	45	68	2	165	210	11
Wet	2	16	16	0	792	1,176	2	1,814	2,622	210
Grand Total		83	91	7	4,906	7,446	35	10,736	15,725	1,469

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY Facility / INTERSTATE ROADS / YEAR 2012

FACILITYDESCRIPTION	FACILITY	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	INJ RATE *	DEATH RATE *	CD **
Not Stated	Not Stated	0	0	0	172	259	2	362	534	43				
Divided, full control of access	3	83	91	7	4,705	7,151	33	10,323	15,111	1,411	63.53	30.06	0.38	6.72
One-way, part of a one-way system	4	0	0	0	12	14	0	30	42	4	62.65	20.88	0.00	4.95
Two-way structure (bridge, tunnel, causeway, etc.	B	0	0	0	13	18	0	19	32	11	76.03	42.77	0.00	8.00
Two-way, non-divided	0	0	0	0	4	4	0	2	6	0	55.68	37.12	0.00	5.56

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY Functional Class / INTERSTATE ROADS / YEAR 2012

FUNCTIONAL CLASS.	DESCRIPTION	FAT CRASH	PER KIL	PED KIL	TOT CRASH	PED INJ	A INJ	INJ CRASH	PER INJ	PD CRASH	CRASH RATE *	INJ RATE *	DEATH RATE *	A INJ RATE *	CD **
1	Rural Interstate	44	48	1	3,858	8	456	1,141	1,761	2,673	42.31	19.31	0.53	5.00	2.95
A	Urban Interstate	39	43	6	11,333	25	970	3,593	5,426	7,701	76.64	36.69	0.29	6.56	11.64
Not Stated	Not Stated	0	0	0	534	2	43	172	259	362					

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

PRIMARY

(Crash Statistics Include VDOT maintained Primary System only)

CRASH SUMMARY BY YEARS / PRIMARY ROADS

YEAR	DVMT	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	A INJ	TOT CRASH	CRASH RATE *	INJ RATE *	DEATH RATE *	A INJ RATE *
2004	67,837,903	335	369	43	15,060	22,081	280	24,490	7,785	39,885	161.08	89.18	1.49	31.44
2005	68,280,142	372	413	29	14,482	21,163	254	24,818	7,332	39,672	159.18	84.92	1.66	29.42
2006	68,057,165	354	395	40	14,208	20,733	259	25,108	7,193	39,670	159.70	83.46	1.59	28.96
2007	68,377,595	380	412	35	13,546	19,703	249	23,999	6,704	37,925	151.96	78.95	1.65	26.86
2008	67,640,841	287	296	27	13,385	19,601	232	21,798	5,336	35,470	143.67	79.39	1.20	21.61
2009	66,250,425	283	306	31	12,232	17,212	215	20,076	4,193	32,591	134.78	71.18	1.27	17.34
2010	66,827,345	258	282	32	11,587	16,032	243	18,854	3,776	30,699	125.86	65.73	1.16	15.48
2011	66,455,490	271	294	27	11,376	17,132	226	18,502	3,341	30,149	124.29	70.63	1.21	13.77
2012	66,406,638	287	313	47	11,600	17,936	280	19,545	3,122	31,432	129.68	74.00	1.29	12.88

* Rate Per 100 Million Vehicle Miles of travel / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY DISTRICT / PRIMARY ROADS / YEAR 2012

DISTRICT	DISTRICTNAME	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	A INJ	TOT CRASH	CRASH RATE *	DEATH RATE *	INJ RATE *	A INJ RATE *
Null	Not Stated	0	0	0	0	0	0	1	0	1				
1	Bristol	23	26	1	917	1,373	13	1,351	404	2,291	128.34	1.46	76.91	22.63
2	Salem	53	61	3	1,252	1,960	19	2,165	438	3,470	133.47	2.35	75.39	16.85
3	Lynchburg	36	41	8	764	1,165	15	1,289	316	2,089	98.93	1.94	55.17	14.96
4	Richmond	38	42	10	1,967	3,309	53	3,916	444	5,921	144.43	1.02	80.72	10.83
5	Hampton Roads	14	14	2	854	1,346	25	1,242	231	2,110	100.77	0.67	64.28	11.03
6	Fredericksburg	30	31	3	1,090	1,687	19	1,871	351	2,991	134.28	1.39	75.74	15.76
7	Culpeper	28	29	3	1,022	1,586	10	1,781	273	2,831	123.98	1.27	69.46	11.96
8	Staunton	35	38	5	882	1,356	6	1,421	315	2,338	119.57	1.94	69.35	16.11
9	Northern Virginia	30	31	12	2,852	4,154	120	4,508	350	7,390	145.61	0.61	81.85	6.90

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY TYPE OF COLLISION / PRIMARY ROADS / YEAR 2012

TYPE OF COLLISION	COLLISIONTYPE	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Angle	02	69	77	2	2,906	5,182	18	4,012	6,987	905
Backed Into	15	0	0	0	12	13	0	72	84	2
Bicyclist	13	1	1	0	26	27	2	0	27	13
Deer	10	3	3	0	191	215	0	2,551	2,745	31
Fixed object in road (from ditch to ditch)	06	0	0	0	62	83	2	150	212	24
Fixed object off road (from outside of ditch)	09	108	116	0	2,279	2,824	4	2,885	5,272	932
Head on	03	32	37	1	350	682	8	317	699	228
Miscellaneous or other	16	3	3	0	184	259	2	303	490	49
Motorcyclist	14	0	0	0	34	38	0	2	36	19
Non-Collision	08	12	12	0	408	488	0	305	725	163
Other Animal	11	0	0	0	36	43	0	145	181	9
Pedestrian	12	42	45	44	218	254	228	1	261	82
Rear End	01	13	13	0	4,438	7,148	11	7,163	11,614	566
Sideswipe - Opposite direction of travel	05	2	2	0	118	205	0	180	300	45
Sideswipe - Same direction of travel	04	2	4	0	338	475	5	1,455	1,795	54
Train	07	0	0	0	0	0	0	4	4	0
Grand Total		287	313	47	11,600	17,936	280	19,545	31,432	3,122

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY LIGHTING CONDITION/ PRIMARY ROADS / YEAR 2012

LIGHTINGS	LIGHTING	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Not Stated	Not Stated	1	1	1	26	53	0	54	81	3
Darkness - Street or Highway Lighted	4	15	15	7	859	1,281	56	1,401	2,275	177
Darkness - Street or Highway not Lighted	5	93	104	27	2,161	3,203	81	4,441	6,695	743
Dawn	1	10	10	1	271	377	4	637	918	69
Daylight	2	158	173	8	7,994	12,535	136	12,481	20,633	2,051
Dusk	3	10	10	3	289	487	3	531	830	79
Grand Total		287	313	47	11,600	17,936	280	19,545	31,432	3,122

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY SURFACE CONDITION / PRIMARY ROADS / YEAR 2012

SURFACE CONDITION	SURFACECONDITION	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Not Stated	Not Stated	0	0	0	15	24	1	16	31	4
Dry	01	245	269	39	9,749	15,083	235	16,241	26,235	2,651
Icy	04	3	3	0	112	161	0	230	345	31
Muddy	05	0	0	0	1	1	0	0	1	0
Natural Debris	08	0	0	0	4	7	0	7	11	1
Oil/Other Fluids	06	0	0	0	5	8	0	8	13	0
Other	07	2	2	0	6	13	0	25	33	3
Roadway Flooded	09	0	0	0	10	16	0	20	30	1
Snowy	03	0	0	0	98	139	0	229	327	20
Wet	02	37	39	8	1,600	2,484	44	2,769	4,406	411
Grand Total		287	313	47	11,600	17,936	280	19,545	31,432	3,122

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY Facility / Primary ROADS / YEAR 2012

FACILITY	FACILITYDESCRIPTION	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	A INJ	TOT CRASH	CRASH RATE *	DEATH RATE *	INJ RATE *	A INJ RATE *
0	Two-way, non-divided	155	171	22	4,576	7,036	109	6,991	1,620	11,722	142.24	2.07	85.38	19.66
1	Divided, no control of access	101	109	18	5,346	8,346	131	9,427	1,152	14,874	141.43	1.04	79.36	10.95
2	Divided, partial control of access	8	10	2	591	878	14	1,015	79	1,614	99.51	0.62	54.13	4.87
3	Divided, full control of access	15	15	3	637	977	6	1,284	166	1,936	52.92	0.41	26.70	4.54
4	One-way, part of a one-way system	1	1	0	61	84	10	101	13	163	224.16	1.38	115.52	17.88
5	Two-way, part of a one-way system	0	0	0	12	17	0	8	1	20	128.63	0.00	109.33	6.43
7	Transition	0	0	0	33	52	0	72	13	105	175.90	0.00	87.11	21.78

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY Functional Class / Primary ROADS / YEAR 2012

FUNCTIONALCLASS	DESCRIPTION	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	A INJ	TOT CRASH	CRASH RATE *	DEATH RATE *	INJ RATE *	A INJ RATE *
2	Rural Other Principle Arterial	65	72	7	1,725	2,634	22	3,053	682	4,843	78.23	1.16	42.55	11.02
3	Rural Minor Arterial	100	110	7	2,243	3,489	29	3,537	875	5,880	120.25	2.25	71.35	17.89
4	Rural Major Collector	36	41	5	1,109	1,703	16	1,647	480	2,792	146.26	2.15	89.21	25.14
5	Rural Minor Collector	0	0	0	0	0	0	2	0	2	131.93	0.00	0.00	0.00
6	Rural Local	2	2	0	46	68	2	81	13	129	218.26	3.38	115.05	22.00
B	Urban Freeways and Expressways; Connecting Links of Rural Principle Arterial	8	8	2	438	674	3	874	97	1,320	50.21	0.30	25.64	3.69
E	Urban Other Principle Arterials; Connecting Links of Other Rural Principal Arterial	51	54	19	4,357	6,749	146	7,380	659	11,788	172.48	0.79	98.75	9.64
H	Urban Minor Arterial	17	18	5	1,166	1,827	34	2,048	203	3,231	208.30	1.16	117.78	13.09
I	Urban Collector	1	1	0	113	163	5	174	17	288	214.48	0.74	121.39	12.66
J	Urban Local	0	0	0	59	83	13	102	18	161	881.64	0.00	454.51	98.57
Not Stated	Not Stated	7	7	2	344	546	10	647	78	998				

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

SECONDARY

(Crash Statistics include VDOT maintained Secondary System only)

CRASH SUMMARY BY YEARS / SECONDARY ROADS

YEAR	DVMT	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	INJ RATE *	DEATH RATE *	A INJ RATE *
2004	31,336,271	261	281	12	12,642	17,493	281	21,597	34,500	6,471	301.63	152.94	2.46	56.58
2005	32,166,027	253	267	19	12,884	17,687	268	22,338	35,475	6,760	302.16	150.65	2.27	57.58
2006	32,808,218	241	259	18	12,430	16,975	311	21,873	34,544	6,076	288.47	141.75	2.16	50.74
2007	33,242,668	284	300	18	11,804	16,027	257	21,161	33,249	5,700	274.02	132.09	2.47	46.98
2008	34,473,559	228	258	13	11,884	16,176	239	19,156	31,268	4,810	248.50	128.56	2.05	38.23
2009	33,177,626	193	209	12	10,859	14,177	254	17,140	28,192	3,854	232.80	117.07	1.73	31.83
2010	33,110,863	205	216	14	10,400	13,257	266	15,964	26,569	3,192	219.84	109.69	1.79	26.41
2011	32,993,630	180	194	10	10,103	14,005	283	16,413	26,696	2,871	221.68	116.29	1.61	23.84
2012	31,316,375	216	236	16	10,277	14,470	310	17,095	27,588	2,757	241.35	126.59	2.06	24.12

* Rate Per 100 Million Vehicle Miles of travel / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY DISTRICT / SECONDARY ROADS / YEAR 2012

DISTRICT	DISTRICTNAME	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	DEATH RATE *	INJ RATE *	A INJ RATE *
1	Bristol	15	19	1	687	965	5	994	1,696	289	265.35	2.97	150.98	45.22
2	Salem	31	34	2	952	1,353	8	1,658	2,641	352	269.55	3.47	138.09	35.93
3	Lynchburg	28	30	0	540	781	10	821	1,389	216	226.30	4.89	127.24	35.19
4	Richmond	36	40	1	1,361	2,031	41	2,682	4,079	398	237.63	2.33	118.32	23.19
5	Hampton Roads	8	9	1	447	652	13	734	1,189	158	229.23	1.74	125.70	30.46
6	Fredericksburg	25	27	2	897	1,290	19	1,627	2,549	280	252.67	2.68	127.87	27.75
7	Culpeper	17	18	1	693	954	15	1,247	1,957	195	240.11	2.21	117.05	23.92
8	Staunton	19	20	1	665	932	18	1,165	1,849	266	233.97	2.53	117.93	33.66
9	Northern Virginia	37	39	7	4,035	5,512	181	6,167	10,239	603	235.47	0.90	126.76	13.87

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY TYPE OF COLLISION / SECONDARY ROADS / YEAR 2012

TYPE OF COLLISION	COLLISIONTYPE	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Angle	02	26	31	0	2,626	4,211	16	4,340	6,992	592
Backed Into	15	0	0	0	25	32	1	200	225	1
Bicyclist	13	0	0	0	58	64	3	0	58	17
Deer	10	1	1	0	106	126	0	1,238	1,345	24
Fixed object in road (from ditch to ditch)	06	0	0	0	58	66	0	150	208	13
Fixed object off road (from outside of ditch)	09	138	149	0	3,326	4,243	3	4,887	8,351	1,264
Head on	03	14	16	0	540	972	9	544	1,098	232
Miscellaneous or other	16	4	4	0	217	282	6	359	580	63
Motorcyclist	14	1	1	0	35	37	0	3	39	20
Non-Collision	08	10	11	0	485	582	0	426	921	172
Other Animal	11	0	0	0	34	38	0	92	126	9
Pedestrian	12	16	16	16	258	282	267	0	274	80
Rear End	01	1	1	0	2,100	2,952	2	3,530	5,631	176
Sideswipe - Opposite direction of travel	05	3	4	0	254	392	2	515	772	68
Sideswipe - Same direction of travel	04	2	2	0	155	191	1	808	965	26
Train	07	0	0	0	0	0	0	3	3	0
Grand Total		216	236	16	10,277	14,470	310	17,095	27,588	2,757

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY TYPE OF COLLISION / SECONDARY ROADS / YEAR 2012

LIGHTINGS	LIGHTING	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Not Stated	Not Stated	2	2	0	27	32	1	94	123	8
Darkness - Street or Highway Lighted	4	14	14	3	782	1,055	51	1,411	2,207	150
Darkness - Street or Highway not Lighted	5	87	97	4	2,249	3,122	66	4,331	6,667	880
Dawn	1	5	5	0	228	295	14	501	734	62
Daylight	2	100	109	8	6,681	9,516	173	10,303	17,084	1,561
Dusk	3	8	9	1	310	450	5	455	773	96
Grand Total		216	236	16	10,277	14,470	310	17,095	27,588	2,757

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY TYPE OF COLLISION / SECONDARY ROADS / YEAR 2012

SURFACE CONDITION	SURFACECONDITION	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ
Not Stated	Not Stated	1	1	0	71	94	0	131	203	21
Dry	01	179	194	14	8,276	11,687	278	13,441	21,896	2,278
Icy	04	1	1	0	66	86	0	189	256	15
Muddy	05	0	0	0	1	2	0	2	3	0
Natural Debris	08	0	0	0	9	9	0	12	21	2
Oil/Other Fluids	06	0	0	0	8	9	0	6	14	0
Other	07	1	1	0	9	15	0	17	27	2
Roadway Flooded	09	0	0	0	5	8	0	8	13	4
Snowy	03	1	1	0	76	106	0	237	314	15
Wet	02	33	38	2	1,756	2,454	32	3,052	4,841	420
Grand Total		216	236	16	10,277	14,470	310	17,095	27,588	2,757

A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

CRASH SUMMARY BY Facility / Secondary ROADS / YEAR 2012

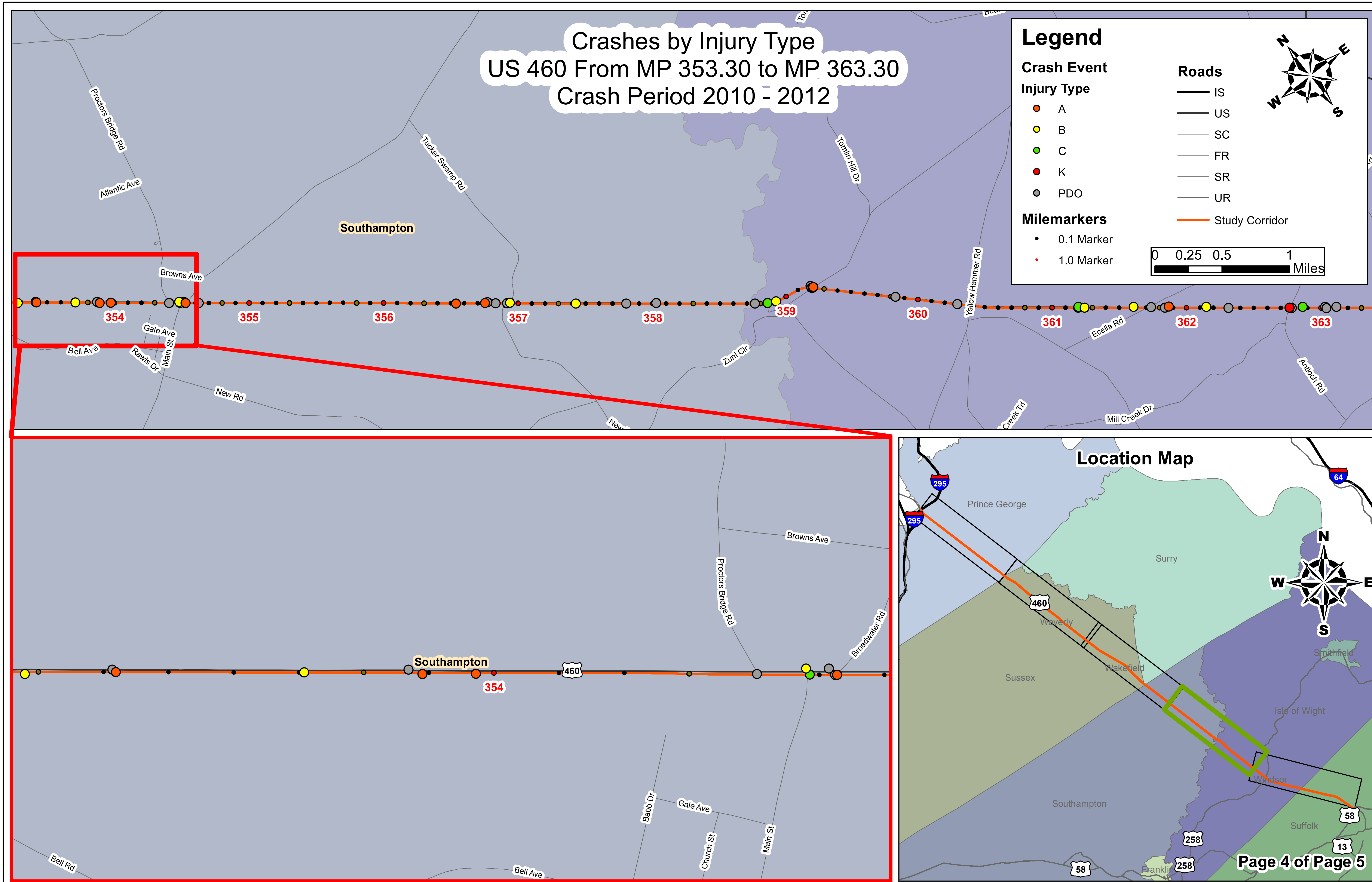
FACILITY	FACILITYDESCRIPTION	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	TOT CRASH	A INJ	CRASH RATE *	DEATH RATE *	INJ RATE *	A INJ RATE *
0	Two-way, non-divided	196	214	10	8,494	11,937	238	14,197	22,887	2,496	237.17	2.22	123.70	25.86
1	Divided, no control of access	9	9	2	1,041	1,469	45	1,677	2,727	150	229.16	0.76	123.45	12.61
2	Divided, partial control of access	6	7	3	439	614	12	672	1,117	44	255.09	1.60	140.22	10.05
3	Divided, full control of access	0	0	0	15	23	0	23	38	1	141.15	0.00	85.43	3.71
4	One-way, part of a one-way system	3	3	0	37	49	0	97	137	8	1,495.10	32.74	534.74	87.31
5	Two-way, part of a one-way system	0	0	0	0	0	0	1	1	0				
7	Transition	0	0	0	31	52	1	45	76	9	387.95	0.00	265.44	45.94
Not Stated	Not Stated	2	3	1	220	326	14	383	605	49				

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality

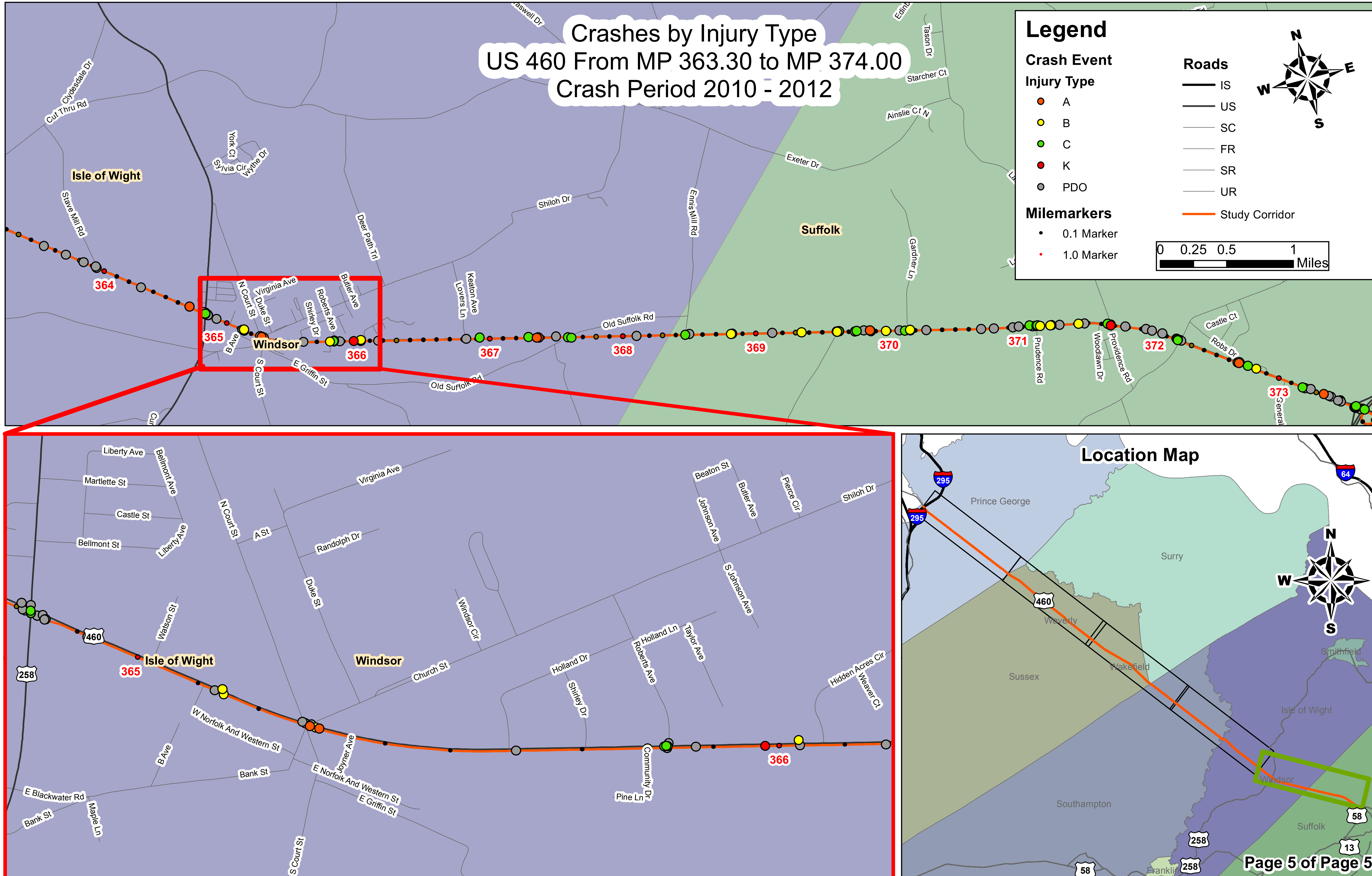
CRASH SUMMARY BY Functional Class / Secondary ROADS / YEAR 2012

FUNCTIONAL CLASS.	DESCRIPTION	FAT CRASH	PER KIL	PED KIL	INJ CRASH	PER INJ	PED INJ	PD CRASH	A INJ	TOT CRASH	B_INJ	CRASH RATE *	DEATH RATE *	INJ RATE *	A INJ RATE *
3	Rural Minor Arterial	1	1	0	42	75	0	80	7	123	44	153.58	1.25	93.65	8.74
4	Rural Major Collector	68	72	1	2,067	2,933	20	3,238	821	5,373	1,475	195.81	2.62	106.89	29.92
5	Rural Minor Collector	20	22	0	413	576	2	631	146	1,064	308	249.19	5.15	134.90	34.19
6	Rural Local	68	76	2	2,030	2,828	28	3,262	787	5,360	1,462	334.40	4.74	176.43	49.10
B	Urban Freeways and Expressways; Connecting Links of Rural Principle Arterial	0	0	0	1	1	0	2	0	3	0				
E	Urban Other Principle Arterials; Connecting Links of Other Rural Principal Arterial	3	3	0	36	61	0	76	4	115	23	171.51	4.47	90.97	5.97
H	Urban Minor Arterial	23	24	5	2,481	3,486	95	3,589	353	6,093	956	201.29	0.79	115.17	11.66
I	Urban Collector	19	22	4	1,681	2,459	49	3,075	340	4,775	1,065	218.73	1.01	112.64	15.57
J	Urban Local	9	10	3	1,275	1,684	102	2,676	242	3,960	656	425.30	1.07	180.86	25.99
Not Stated	Not Stated	2	3	1	220	326	14	383	49	605	183				

* Rate Per 100 Million Vehicle Miles of travel / ** CD - Crash Density Per Mile / A - Severe Injury / PED -Pedestrian / Inj - Injury / PD - Propery Damage / Fat - Fatality


Crashes by Injury Type
US 460 From MP 353.30 to MP 363.30
Crash Period 2010 - 2012
Legend
Crash Event
Injury Type
A
B
C
K
PDO
Milemarkers
0.1 Marker
1.0 Marker
Roads
IS
US
SC
FR
SR
UR
Study Corridor
0 0.25 0.5 1
Miles
N
E
S
W
Proctors Bridge Rd
Atlantic Ave
Tucker Swamp Rd
Tomlin Hill Dr
Yellow Hammer Rd
Southampton
Browns Ave
Gale Ave
Bell Ave
Rawls Dr
Main St
New Rd
Zuni Cir
Ecella Rd
Antioch Rd
Mill Creek Dr
354
355
356
357
358
359
360
361
362
363
Broadwater Rd
460
Babb Dr
Church St
Bell Rd
Location Map
295
64
Prince George
Surry
Waverly
Wakefield
Sussex
Smithfield
Isle of Wight
Windsor
Southampton
Suffolk
58
258
13
Franklin
Page 4 of Page 5

Crashes by Injury Type
US 460 From MP 363.30 to MP 374.00
Crash Period 2010 - 2012



APPENDIX B: ENTRADA FILES (Complete set of electronic files available upon request)

APPENDIX C: SYNCHRO FILES (Complete set of electronic files available upon request)

US ROUTE 460 FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT